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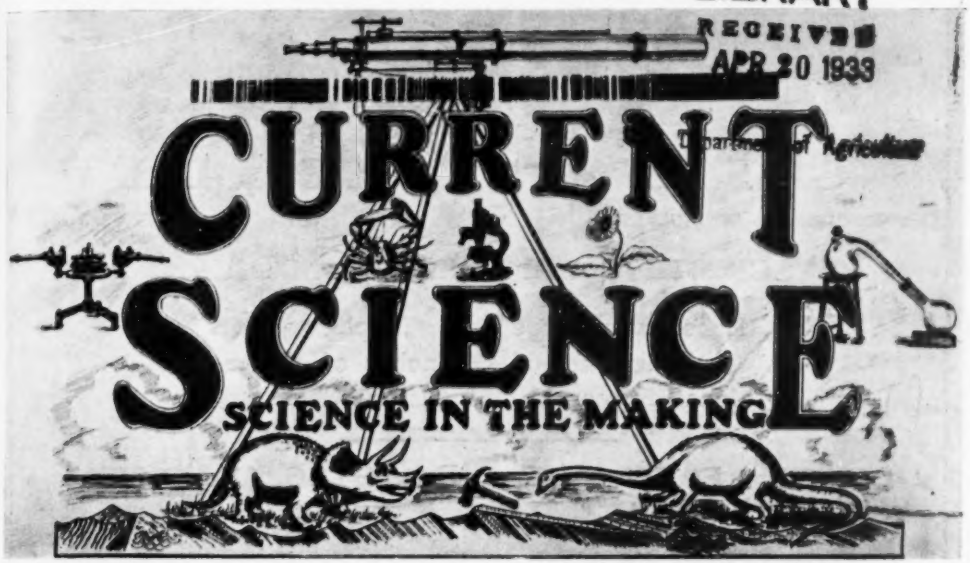

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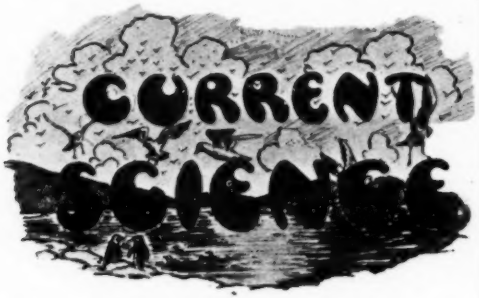

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Science and the Pace of Life.

IN an interview with a press correspondent at Bremen before he went on board the liner, 'Oakland', for San Francisco, Professor Albert Einstein is reported to have said that the present pace of life was too fast for the man-in-the-street even to catch the newspaper headlines and it was imperative that we slowed down. "A few years ago people had a chance to sit down and think. It could not be helped if some did not make use of the opportunity, but now no one is in a position to stop and think even if he desires to do so. We are moving too fast to allow a general understanding of science. The public is not much interested in it nor does it understand science. It is paradoxical, but apparently true, that the very instruments of science, instead of being devoted to help common men to a greater understanding of reality are doing just the opposite and are only succeeding in befuddling things even more. Scientific technique is growing so fast that it must soon slow down to permit the ordinary man to catch up."

To a casual reader of these sentences, if they have been reported correctly, they might seem to contain a severe indictment of the attitude of scientists towards the general public, and might even be understood to convey the impression that Professor Einstein thought that the progress of scientific investigations would not lose much if they were suspended for such time at least as would enable the common people to assimilate their great advances. It is perfectly true that the rush of modern life in Europe and America is far too tumultuous and excited to permit the man-in-the-street to stop and think of what is going on around him but science may not be the only contributory cause of this senseless impetuosity. We seem to forget that 'the world has not and never had any assured hope of progress and perfectibility' and neither acts of Parliament nor achievements of scientists can coerce them. The restlessness and discontent of the present age have their roots in social and economic causes and it is doubtful if the progress of science assisted in their acceleration. Most men are the victims of half-knowledge which is worse than honest ignorance, and being products of a bad system of education, are unable "to turn the light of knowledge on

their own hearts while doing their own work." The present age has ceased to regard leisure and tranquillity as indispensable for adorning human environment and has placed implicit faith in wealth as the chief necessity for the embellishment of life.

This change in the scale of human values must account for the feverish pleasures and restless frivolities connoted by the "pace of life" to which Professor Einstein refers. Human happiness is conceived as centering in material comforts and the doctrine which assigns a subordinate position to worldly goods has become infructuous. The suggestion that greed is misery and its absence, happiness will have no meaning to the age which worships the golden calf. The thriftless yearning for money accounts for the mad rush of life and the unequal distribution of wealth, for much of the world's wickedness. There have been great civilizations in the past history of the world in which the ostentatious display of wealth formed the most conspicuous feature of the national pomp and pageantry, but history does not record that the people were consumed by such sinister passions as disfigure modern civilization. If in the days of the Mauryan dynasty and under Gupta administration unlocked doors did not excite the cupidity of the people, a great atavistic change must have since come over the human mind, a certain section of which laughs at locks, safes and science. Under the influence of growing industrialism, the concentration of population in urban areas, the stress of economic competition and the general prevalence of squalor, crime and poverty, the human mind has been insidiously estranged from spirituality which has been for ages its sheet anchor. The principal defect of modern civilization is the total absence of the fear of the Lord whose place is taken by Scotland Yard and the magistrate. The criminal, therefore, embarks on his private enterprise fairly convinced that he can elude human eyes and all other forms of anti-social practices are traceable to the same cause.

The invention of rapidly moving vehicles has brought the continents nearer each other, promoted commerce, stirred the instincts to accumulate large wealth and has also spread disease and has enabled international gangsters to set up *alibis*. The quieter and more normal aspects of life have nearly ceased to interest us and the growing tendency for the sensational and the abnormal is reflected in our public tastes, amusements, fashions and literature. This morbid craving for stupefying thrills which is becoming general, is symptomatic of the degenerative process of the human mind which has missed the essence of absolute life, its hopes, its beauties and its ideals. The conflict between religion and science which occupied the greater part of the nineteenth century, has been wrongly assumed to have proved that the ideals of the former are thrown into the unknown future, thus paving the way for the purely materialistic conception of life. The attempt to interpret the world in mechanical and quantitative terms has led to the application of these principles to human life which was conceived to be an automaton and which, escaping from the stern discipline imposed by religious ideals, seeks its pleasures limited rather by the power of its enjoyment than by the apprehension of their effects on its intellectual, moral and spiritual endowment. The reason for the human mind's breaking away from religious doctrine is partly due to its non-recognition of man as an organic factor of the world and no theory which separates the two can satisfy philosophy and science. We are reaping the fruits of the supposed senseless antagonism between science and religion and its manifestations must necessarily perplex thinking minds. Instead of being mutually antagonistic, they represent the two modes of approach to the same problem, *viz.*, life, in the investigation of which both are handicapped by the limitations of human intelligence and the defectiveness of the instruments of study. We are more conscious of our life than all the facts and evidences against 'life' as a spiritual entity and this very imminence of 'conscious life' baffles a detailed conception of its essence. The limitations of science are not different from those of the human mind and their continuance must indicate that the intuitive perceptions on which religion bases its doctrines of right and wrong, are quite as safe a guide as any that can be wished for. The promptings of the heart are far more true than the ratiocinations of the head.

The pace of life is not set by science alone though its discoveries on the practical side may have given it an impetus. Science is occupied with the investigations of the properties of matter, their causal relations and their behaviour under certain induced and normal conditions but its office does not cease with the discoveries which it

makes. It has a higher purpose and nobler destiny. Most of these discoveries have a practical application which may be directed to the improvement of life as well as its destruction, but science does not lead the way to either. The prostitution of the gifts of science is the business of the commercial and industrial syndicates and of the Government. It is here where the scientific results are applied to the practical problems of life that the pace commences, stimulated largely by economic competition, trade jealousy, fat dividends and capitalization of industry. The hunting after money like every species of hunt, is intoxicating and in its mad pursuit, the graces and beauties of life are ruthlessly sacrificed for those goods which all religions condemn as the parents of every vice and wickedness. The gold frenzy is at its critical point just now and when it subsides religion and science will have to step in to increase the wealth of the world by substituting new values in regard to human happiness which is at present treated as synonymous with material comfort. It is when we have reintroduced fear and admiration in our town life which is marred by social unrest, when we have humanised the commercial and industrial organizations which are riddled by maladjustments, when the rural population is enlightened enough to become intelligent participators in the gifts of learning and in civic administration that hopes may be entertained of the co-ordinated progress of the nation, with sufficient leisure and tranquillity to devote time and talents to the enrichment of their home and environment.

No one can be more vividly conscious of the limitations of science than he who has lived it, and its function is "no more to save our bodies than it is to save our souls". It seeks to uncover the veil of nature and deals with her facts and phenomena disclosing new worlds of thought, reality, laws and history of the visible universe. With the more technical parts of science, the general public can have very little to do, but it ought to be possible for those who have attained a reasonably high degree of education to become acquainted with the general advances of those departments of knowledge in which they are most interested or in which they have received their earlier training. To democratise science need not necessarily involve its degradation. At present the whole firmament of public life is dark, illumined here and there by a few stars of the first magnitude whose glory is scarcely discernible in the immense general gloom of the sky. What Professor Einstein wishes is a widespread diffusion of light throughout this vast area, each body in it having the power of self-luminescence. It would be too narrow a view to take that the task of science begins and ends with research; for if the knowledge of science is good then it must be good for something and for somebody. It is perfectly legitimate for the scientist to emerge from the laboratory and give the people who care, an account of the joys and pleasures and the difficulties and trials in the prosecution of his studies and make them feel the same thrills, and participate in the cultural benefits which may have accrued to the investigator himself. All the agencies that are impressed in this task, *viz.*, the Universities, the learned societies, the scientific associations and congresses and the press, have established wide channels of communicating knowledge to the general public, but their efforts are obscured by causes over which science has little control. We have to cure the gold fever before science can come to its own.

In India the task is far harder. Education has scarcely touched the outer fringe of the vast population. Those who have received the benefits of education are interested in matters and problems far removed from science. The younger generation is concerned more with the task of obtaining a livelihood than with extra courses of studies for the cultivation of mind. Those that have worldly goods, leisure and a fair measure of tranquillity are engrossed with activities naturally befitting their station in life. To the businessmen science is a superfluity. The Indian universities are nevertheless engaged in overcoming the inertia and in improving the pace of life in the right direction; but it will certainly take a long time for an exotic knowledge conveyed best in the foreign language to permeate and enlighten the whole of the Indian population. Whether it be in India or in any country, public life when freed from the tyranny of gold will instinctively seek knowledge, create leisure for the enjoyment of the beauties of art and literature, acquire power to visualise the higher ideals and the ambitions of a larger life than the one circumscribed by the narrow limits of industries, commerce and lop-sided progress.

Hyperfine Structure of Elements in Mercury Arc—I.

NUCLEAR MOMENT OF ZINC 67.

By Prof. B. Venkatesachar, M.A., F.Inst.P., and L. Sibaiya, B.Sc., A.Inst.P.

THE mass-spectrograph analysis of the isotopic constitution of zinc by Aston (*P.R.S.*, **130**, 302, 1931) has revealed the existence of seven isotopes with relative abundance as given below:

Mass Number	64	65	66	67	68	69	70
Percentage abundance	48.0	2.5	25.9	5.3	17.1	0.85	0.38

Recently, Bainbridge (*Phys. Rev.*, **39**, 848, 1932) has shown that the ions of mass numbers 65 and 69 measured by Aston were hydrides of Zn 64 and Zn 68. Bainbridge's densitometer curve of the mass-spectrogram seems to indicate that the percentage abundance of Zn 67 is considerably greater than Aston's estimate. It can, however, be safely assumed that this odd isotope has an abundance not exceeding 10%. If as in the case of cadmium the odd isotopes give rise to the satellites, in zinc they must be expected to be far less intense relative to the main lines than in cadmium or mercury, where the relative abundance of the odd isotopes is 23% and 30% respectively. The small percentage of the odd isotope 67 along with its comparatively low atomic weight renders the satellites of zinc lines faint and fuzzy. The failure of the early observers to obtain hyperfine structure in zinc lines is to be traced to this cause. Schüler and Brück (*Z.P.*, **56**, 291, 1929) finding the lines simple concluded that the result was due to the absence of odd isotopes, Zn 67 being then unknown. Snoek and Bouma (*Z.P.*, **38**, 368, 1926), Wali Mohammed (*P.M.*, p. 1112, 1928) and McLennan and Allin (*P.M.*, **8**, 515, 1929) had even earlier found the lines to be single. More recently Schüler and Keyston (*Z.P.*, **68**, 174, 1931) and Murakawa (*Z.P.*, **72**, 793, 1931) have independently come to the conclusion that the nuclei of all the isotopes of zinc have zero moment based on the fact that the lines show no structure. Hence in this re-examination of the zinc lines it was thought necessary to devise an experimental arrangement in which the satellites are relatively enhanced without introducing complications arising from self-reversal.

The source used is a long column mercury arc, more than 30 cms. long, with a current density of about 1.5 amperes per sq. cm., through which a slow stream of zinc vapour is continuously passed. The apparatus in Fig. 1 is made of Pyrex glass with a detachable fused quartz window W at one

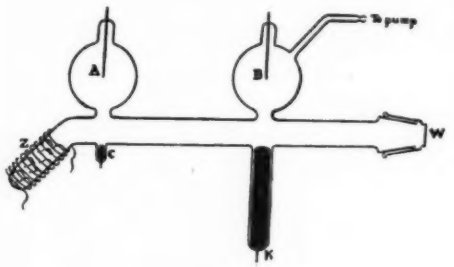


Fig. 1.
Diagram of Source.

end for observation. When the necessary vacuum is reached, the main arc between the mercury cathode K and the tungsten anode B is started, and a few minutes later the long column arc between K and A lights up. The main arc is then switched off. The zinc in the side tube Z is then gradually heated electrically and a stream of zinc vapour is passed through the long arc. The axial radiation is first analysed by a Hilger E_1 spectrograph with a glass train and each line of the zinc triplet $4^3P_{012}—5^3S_1$ is separately examined by three Lummer plates, all of them definitely known to give ghost-free patterns. Assuming that the ratio $\frac{\text{emission}}{\text{absorption}}$ is the same for all the components of a line, it follows that in a long column the weak satellites, suffering little absorption relative to the main line, are enhanced. An examination of the photographs of the triplet patterns reveals indubitably the existence of hyperfine structure in zinc, but because of the faintness and diffuse character of the satellites the following values require further confirmation:—

Line		Structure $\Delta\nu$ in cm.$^{-1}$ (Int.)
4810	$4^3P_2-5^3S_1$	+0·319 (1)
		+0·147 (2)
		0·000 (10)
		−0·177 (1½)
		−0·315 (0)

Line		Structure $\Delta\nu$ in cm.$^{-1}$ (Int.)
4722	$4^3P_1 - 5^3S_1$	+0·342 (1)
		+0·131 (2)
		0·000 (10)
		−0·153 ($\frac{3}{4}$)
		−0·288 (0)
		−0·365 ($\frac{3}{4}$)
4680	$4^3P_0 - 5^3S_1$	+0·271 (0)
		+0·087 (1)
		0·000 (10)
		−0·155 (1)
		−0·409 ($\frac{1}{2}$)

Figure 2 gives the densitometer curve of Zn I 4680 Å $4^3P_0 - 5^3S_1$ kindly taken by

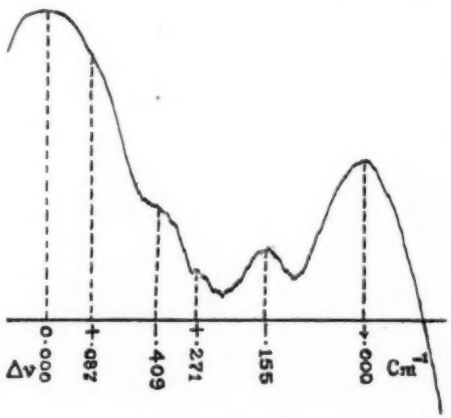


Fig. 2.

Microphotogram of the Lummer plate pattern of the Zn I 4680 Å.

Messrs. Carl Zeiss and shows clearly all the satellites of this line. The observed structures for these lines indicate that the nuclear spin moment of the zinc isotope Zn 67 is most probably $\frac{1}{2}\frac{h}{2\pi}$ and the hyperfine levels are all regular and not inverted as in the case of cadmium. Based on these assumptions a tentative scheme of levels proposed is indicated in Fig. 3. This accounts for most of the observed satellites, only a few relatively fainter ones remaining unexplained. The main lines as in the case of cadmium have to be ascribed to the even isotopes of zinc. The observed hyperfine structure cannot be the result of the shift due to the several even isotopes, as the relative intensities of the components bear no resemblance to the relative abundance of the even isotopes.

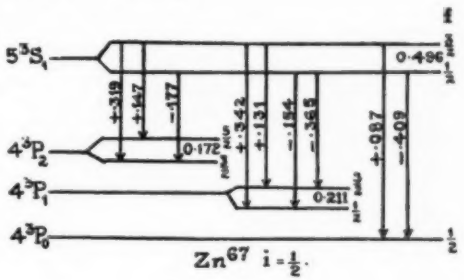


Fig. 3.

The fact that other investigators have almost invariably reported the absence of structure in the prominent arc lines of zinc raises the question whether in the present case, the large admixture of mercury vapour has not any influence in bringing up the satellites. We raise this question because in the case of cadmium under similar conditions of excitation we have observed additional satellites which do not work into the Schüler scheme. The same is the case with the line 5351 Å of Tl I. It must, however, be admitted that one has to establish beyond doubt that the presence of a foreign substance such as mercury is a necessary condition for the appearance of these additional satellites. There is always the possibility that these faint satellites may be caused by isotopes present in such small relative abundance that the mass-spectrograph has not been able to reveal them. Or on the other hand if the conditions of excitation, the presence of a foreign vapour and other factors influence the structure so far as the faint satellites are concerned, we shall have to trace their occurrence to a cause hitherto not considered. For on the hypothesis of a nuclear spin alone, it becomes increasingly difficult to understand why a change in the conditions of excitation should bring out new satellites. The insufficiency of the present theory to account for the hyperfine structure phenomenon in all its aspects has, however, been pointed out by other investigators.

The Problem of the Lantana.

By A. V. Varadaraja Iyengar, M.A., M.Sc., A.I.C., A.I.I.Sc.,

Department of Biochemistry, Indian Institute of Science, Bangalore.

IT seems almost incredible that a small ornamental hedge shrub introduced into India about a century ago should have developed into pest proportions and overrun millions of acres of cultivable land and forest areas in almost every province of this country! Yet such is indeed the case: the menace of the lantana is one of the most serious problems of India to-day and unless a quick and cheap method of controlling its spread is soon discovered, the rapid invasion of this naturalized exotic will do incalculable harm to the preservation and progress of agriculture and forestry in the country.

Lantana Camara Linn (*Syn. L. aculeata* Linn) belongs to the natural order, *Verbenaceae* and would appear to have been originally introduced into this country from Mexico. It is a thorny shrub with re-curved prickles on the stems and branches, leaves possessing a strong and pleasant odour and flowers varying in colour from yellow to crimson. The fruits, which are formed in large numbers practically all round the year, resemble black drupes and are readily consumed by birds and animals, which disseminate the seeds through their droppings. Under favourable conditions the shrub forms a dense, impenetrable growth often reaching a height of over ten feet, the thorny branches forming a network resulting in a closed canopy. The plant flourishes under varying soil and climatic conditions, in regions of high and low rainfall (200—30 inches per annum), in rich as well as poor soil and in low-lying regions as well as on hill slopes upto a height of about 4,500 ft. above sea-level. Its growth is most intense among the uncultivated lands and scrub-type jungles of the Deccan plateau, parts of the Vindhyas, Chota Nagpur and Assam, while in the deltaic regions, particularly those on the East Coast, it is either sparsely distributed or does not occur at all.

The lantana is, normally, a light-loving plant but it can also grow under moderate shade. It withstands drought, is highly tenacious of life and regenerates quickly after being cut, trampled or burnt by fire. The plant burns readily even in the green thus facilitating the spread of forest fires and consequent destruction of more valuable species. After the fire the lantana is the first to recover; it comes up with a denser growth than ever before and thus smothers out other species that may regenerate more tardily. It propagates readily from stumps or cuttings but in the field or jungle the regeneration is generally from seeds.

During recent years the spread of lantana has been enormous and rapid. About 50 years ago, the shrub was found in isolated patches in uncultivated and fallow lands but now it has spread throughout India and Burma, particularly in the Deccan plateau, where it encroaches even on cultivated lands with the result that its eradication has now become one of the most important and immediate problems of the farmer. Unfortunately no systematic record of the spread of lantana in different parts of the country is available but the following data relating to four forest ranges in North Salem, Madras Presidency, would illustrate the position:—

Range	Area under lantana in acres		Spread during the interval
	1917	1931	
Dharmapuri	Nil	20,844	20,844
Anchetti	45	37,524	37,479
Denkanikota West	1,472	45,806	44,334
Denkanikota East	2,005	35,090	33,085

In the district under reference the area under lantana has increased from about 3 to 42 per cent of the total forest lands within a short period of fourteen years. Judging from the present rate it is not improbable that almost the entire area of not only North Salem but also the remaining part of the Deccan plateau will soon be overrun by this highly aggressive shrub.

Further instances of the dangers arising from the spread of lantana are not wanting. Culturable wastes and fallow lands are rendered unworkable: the soil is depleted of its nutrition and subsequent crops almost invariably fail. The erstwhile grazing grounds are now covered up with lantana which, in addition to suppressing the growth of grass, also prevents the cattle and sheep from gaining access to the little that may be enclosed within. In the deciduous type of forests lantana is chiefly responsible for periodical outbursts of forest fire while in the semi-evergreens it is steadily ousting the

more valuable species, causing degeneration from the original climax type. Lantana is a bad host for sandal because it fails the latter in seasons of drought and subjects it to excessive shade in others. Judging from the high incidence of sandal spike in lantana areas, the shrub would appear to be, in some way, connected with the spread of that dreaded disease. In many parts of the country lantana is found to harbour injurious insects including malarial mosquitoes so that it becomes a source of danger to other plant life and a menace to public health.

The existence of lantana is not, however, an unmixed evil: it has also got some valuable properties which have either not been fully understood or adequately utilized. In addition to making an ornamental hedge plant, its ability to thrive on some of the poorest soils like gravel or hard laterite facilitates the opening up of areas which are inhospitable to most other plant species and which would otherwise become rocky and barren. The plant itself contains several valuable ingredients, some of which are being utilized while the others are still awaiting proper application. The leaves and flowers contain essential oils which were studied by Kanga (*Jour. Indian Inst. Sci.*, **1**, 93, 1914-18) and later by Moudgil and his co-workers (*Perf. and Ess. Oil Rec.*, **13**, 173, 1922; *ibid.*, **16**, 9, 1925). The oils are yellow in colour with pleasant and somewhat powerful odour: they are being distilled by some firms but their uses would still appear to be obscure. Edel Behram investigated the possibility of using the leaves as substitutes for tea. He detected the presence of a large number of enzymes including a powerful oxidase corresponding to that present in tea. He fermented the leaves and obtained a product which though resembling tea in appearance did not yield a beverage of the same quality (*Jour. Indian Inst. Sci.*, **2**, 195, 1918-20). The above study was essentially a preliminary one and requires repetition under standard factory conditions. De, Ganesh Rao and others have shown that the composition of different parts of the lantana plant, particularly the leaves, would point to their being suitable for the manufacture of synthetic organic manures (*Agri. Jour. India*, **25**, 143, 1930): the more recent observations of Subrahmanyan and Jagannatha Rao show that composts prepared out of lantana contain a fairly high percentage of phosphoric acid, a constituent which is sadly wanting in most Indian soils (*Jour. Indian Inst. Sci.*, **15A**, 89, 1932). The possibility of using the twigs for the generation of heat and power, the manufacture of mineral fertilizers from the residual ash, the products of destructive distillation of the whole or different parts, the application of the residual charcoal for adsorptive or clarifying operations in arts and manufacture, the disinfective and insecticidal properties of the oils and related preparations, the uses of the variegated pigments present in abundance in the flowers—these and related problems are still awaiting solution.

Although the aggressive and pestilential nature of lantana would provide a strong argument for its eradication, yet the few good qualities which it is known to possess and the inadequacy of our knowledge regarding the others would justify its retention provided it does not endanger the life of other valuable plant species in the forest or on the field. The problem would, therefore, resolve itself into one of controlling the distribution and spread of lantana.

In recent years, several attempts have been made, particularly in South India, to check the spread of lantana but, unfortunately, without much success. The problem engaged the attention of the Coorg Government as early as 1912. Tireman drew pertinent attention to the evil effects of lantana on other forest species, particularly sandal, and proposed an elaborate scheme for its elimination from that province. His method consisted in stumping the plants in February or March and removing the cut material away from the stumps and burning it. The stumps were to be subsequently pulled out in the rainy season when the ground is soft. Frequent uprootal in the above-mentioned manner for at least four years were considered necessary to ensure the success of this mechanical operation (*Indian Forester*, **42**, 385, 1916). Tireman's scheme involved the clearing up of 63,000 acres in the course of 12 years at a total cost of 4½ lakhs of rupees, but unfortunately it was not adopted. A special legislation known as "The Coorg Noxious Weeds Regulation" was introduced in 1914, but no action seems to have been taken to prevent the natural spread of lantana.

Insect control of lantana is claimed to have been successful in the Hawaii islands where the agromyzid fly feeds on the immature seeds and thus prevents the

regeneration of the plant. With a view to determining whether similar methods of biological control would be possible in India, the Government deputed Rao Bahadur Y. Ramachandra Rao in 1916 to study the insect relations of lantana and to suggest means of checking its spread. The results of the investigations are embodied in a long and useful report (*Dept. Agri. India, Memoirs Ent. Series*, **5**, No. 6, 1920) wherein the author has listed the various species of insects visiting lantana. No evidence could, however, be found to suggest that any of the indigenous species is capable of keeping the shrub sufficiently under check. The author suggested, therefore, that the foreign fly should be imported into India. The proposal did not, however, meet with general approval: in the preface to the Memoir under reference, Mr. Bainbridge Fletcher, the Imperial Entomologist, viewed with apprehension the possibility of the agromyzid fly proving a menace to the other members of the order *Verbenaceae* and, in particular, to teak (*Tectona grandis*) in which case the loss will be irreparable. Some attempts were still made to introduce the agromyzid fly into India. Dr. Kunhi Kannan obtained a few insects with great difficulty and released them in Bangalore: but though he was satisfied that the insects did no harm to teak, he could not yet get them to 'catch' on lantana with the result that they all escaped and could not be subsequently traced, despite careful search! (*Agri. J. India*, **19**, 504, 1924.) Even in Hawaii the agromyzid fly has no very marked effect on lantana: the area under that shrub has always remained small so that it is difficult to define the possible efficacy of introducing the insect into India on a large scale. The insect would not appear to be as specific in its action on lantana as is the cochineal insect on prickly pear so that the possibility of effectively controlling the spread of lantana by the introduction of that seed fly would appear to be rather remote.

Cultural control of lantana is a promising line of enquiry, but no systematic attempt in this direction has so far been made. There is evidence to show that certain soil conditions as also the floristic make up of certain regions are highly effective in checking the spread of lantana. Even in areas like North Salem where lantana abounds there are numerous little patches where the shrub either makes poor growth or does not appear at all. In certain localities where the soil contains a high percentage of kaolin or certain other light, silicious earths, lantana is generally absent while other species flourish. It has already been stated that lantana does not thrive under dense cover and that heavy foliaged species of the high forest type generally keep out the incursion of this shrub. As an instance of this it may be mentioned that in the Siddapuram R.F., in North Salem, lantana does not grow under the heavy shade of the evergreen shola species and even in places where it has gained entrance the shrub invariably exhibits a weak growth. It is true that the introduction of *Ficus elastica* or castor did not prevent the spread of lantana in certain parts of Madras, but further systematic study might reveal the presence of more powerful species that would not only check the spread of lantana but would also help to eliminate it from other areas.

The use of chemicals for the eradication of undesirable plants is well known and is extensively adopted in America. There are a number of cheap inorganic and organic chemicals which are deadly in their action on all forms of plant-life: there are others which are selective or specific in their action. It is not improbable that a judicious application of one or both of the above types of compounds would be helpful in either keeping down lantana or eliminating it altogether. To be efficacious, the chemical must be easy of application and possess high penetrative power reaching the farthermost ends of the plant; it must be highly toxic even at low concentrations and effective irrespective of season. A thorough knowledge of the physiology of the plant is also essential to gain an insight into the nature of its response to various treatments. An investigation into the above and related aspects of the problem has been undertaken by the author in co-operation with the Madras Forest Department. Various observations of interest have already been made both in the laboratory and on the field among which particular mention may be made of the fact that chlorates and arsenicals are highly effective in killing lantana. A study of the various methods of application is also under way.

Much more yet remains to be done. The extent of spread of lantana in different provinces, the rate and manner of its progress, its effect on other forms of vegetation and its relation to plant pests and carriers of human disease require investigation

in detail. The precise nature of the soil conditions that check the spread of lantana has yet to be ascertained. A systematic survey of the ecology of that shrub has to be made in different parts of the country, particular attention being paid to areas where other forms of vegetations have steadily dominated over lantana, so that the observations with regard to the flora as well as the fauna of such localities may provide the necessary clues to similar control in other places as well. The introduction of the foreign fly does not appear to be a promising line of attack, but in view of the incomplete evidence provided by the previous work, some further trials may be carried out with that insect. In the laboratory a great deal of systematic work is still awaiting to be investigated. Some useful beginnings have no doubt been made at the Indian Institute of Science, but more intensive work has still to be carried out, particularly with regard to the conversion of the different parts of the shrub into synthetic organic manure for use in areas where other forms of vegetation are scarce. Attention should also be paid to the economic combustion of the plant for generation of energy, the utilization of the different products of distillation in arts and manufacture, and the exploitation of the ferments, oils and other constituents already known to be present in the plant. The observations on chemical control have to be repeated in various provinces and in different seasons and the conditions standardized for extended adoption of the technique. The above and related problems are of considerable practical importance and it is earnestly hoped that they will soon engage the attention of the Imperial Council of Agricultural Research, the Forest Departments of the different provinces and the scientific laboratories in different parts of the country.

The author desires to express his thanks to Dr. V. Subrahmanyan for many helpful suggestions, and to Messrs. A. M. C. Littlewood and S. Rangaswamy for co-operation in the research and much valuable information in connection with the occurrence and spread of lantana.

Obituary.

Lt.-Col. John Stephenson, I.M.S., C.I.E., F.R.S.

THE sad news of the sudden death of Lt-Col. John Stephenson, C.I.E., M.B., Ch.B., F.R.C.S., D.Sc., F.R.S., F.R.S.E., I.M.S. (retd.), on 2nd February 1933, came as a great shock to his old pupils and friends throughout India.

Colonel Stephenson was born in 1871 at Padiham, Lancashire, and was educated at the Burnley Grammar School and the University of Manchester. In Manchester he had a very distinguished career in zoology and medicine. After qualifying as a doctor Stephenson acted for a time as the House Surgeon in the Manchester Royal Infirmary and the London Hospital for the diseases of the chest till in 1895 he passed the competitive examination for the Indian Medical Service. For the first five years of his service in India he was on military duty and saw active service with the North-West Frontier Expedition of 1897. He was posted as a medical officer on plague duty in the Punjab in 1900, and up to 1906 served as a Civil Surgeon in Rawalpindi, Gujrat, Ambala and other places. Early in 1906 he went on leave and passed the Fellowship examination of the Royal College of Surgeons, London, with a view to appointment as Professor of Surgery in the Lahore Medical College. Fortunately for the study of zoology in India, the recent experiment of the transfer of the teaching of pure science subjects, like botany and zoology, from the Medical College to the Government College, Lahore, had not, for want of properly qualified teachers, proved the success that its initiators had hoped. The then Lieutenant-Governor of the Punjab, Sir Denzil Ibbetson, who was a personal friend of Colonel Stephenson, knew that Stephenson had studied zoology in Manchester under the famous professor A. Milnes Marshall, and knowing Stephenson's capacity as an organiser and worker, he prevailed on him to undertake the duties of the recently created professorship of biology in the Government College, Lahore. He held this position till 1912 when, in addition to being the Professor of zoology, he was appointed Principal of the Government College, Lahore. He retired from service in India in September 1921, and went over to Edinburgh where he was appointed Lecturer in zoology in the University. In November 1929 he left Edinburgh for London and till shortly before his death he used to carry on zoological researches in the British Museum of Natural History as an unofficial worker.

On his appointment as Professor of biology in 1906 Stephenson, who had been out of touch with zoology for nearly eleven years, started earnestly to brush up his knowledge of the subject and bring it up-to-date. Though he had a fairly good teaching museum at his disposal there was neither a properly equipped laboratory nor any library worth the name in the Government College, Lahore. He was, however, able to get together before long a first-rate teaching museum, a very good working library and by 1914 had succeeded in having a new biological laboratory built for the institution in which he was working. As a result of his labours, zoological instruction in Lahore attained a very high standard in a few years and he was able to found a very productive school of zoology in the Government College. Several students from his laboratory, in whom he instilled the faculty of critical work and careful investigation from the very beginning, are now holding influential zoological positions throughout the country, and it was solely due to his initiative and interest that a really flourishing school of zoological research was established in Lahore. His tenure of office was marked by conspicuous success as a teacher, while his administrative qualities were responsible for making the institution under his charge into a really

first-rate place of instruction. He also took a very active interest in the affairs of the Punjab University and in addition to being the Dean of the Faculty of Science, he acted during the last year of his stay in India as the Vice-Chancellor of the Punjab University.

Stephenson was not content with teaching zoology only, but started research work in zoology soon after his appointment in Lahore and by 1909 had produced a thesis which earned for him the degree of Doctor of Science of the London University. His researches from the very beginning were concentrated on the Oligochætes, and from 1907 onwards till shortly before his death he published numerous papers on Oligochætes of India and other areas. The results of his systematic work on Indian Oligochætes for over 16 years were collated in his volume on the Oligochætes in the "Fauna of British India" series and since that date he was recognized as one of the two chief authorities on this group of worms. In 1929 he completed the masterly morphological and systematic monograph on the Oligochætes which was published in 1930 by the Clarendon Press, Oxford. In addition to the systematic studies on the Oligochætes he carried out researches of outstanding character on the intestinal respiration of Oligochætes and worms in general, and published several very important morphological papers on the structure of these worms in the "Transactions of the Royal Society of Edinburgh" and the "Proceedings of the Royal Society of London". His monograph on the Oligochætes clearly indicates his extensive knowledge of the structure and classification of the Oligochætes and a very thorough acquaintance with the literature on the subject. In addition he dealt in detail with such important questions as convergence, the polyphyletic origin of the various genera and families and the geographical distribution of earthworms. In connection with the distribution of these worms he discussed in detail the former existence of an Antarctic continent and land-bridges between India and Australia on the one hand and the Peninsular India and Africa on the other. He also published a very valuable account of the Nemertines of the River Clyde in the "Transactions of the Royal Society of Edinburgh".

Stephenson was a great linguist and all his spare time was devoted to the study of early Persian authors. He published a collated edition of all the known manuscripts of *Hadiqat-ul-Haqiqat* in the "Bibliothica Indica" published by the Asiatic Society of Bengal together with an English translation and annotations of the *Muzhat-ul-Qulub* in the publications of the Royal Asiatic Society of London.

For his work as an administrator and teacher Colonel Stephenson was awarded the title of C.I.E. in June 1919. His contributions to the advancement of knowledge were recognized by the award in 1920 of the Keith Memorial Medal of the Royal Society of Edinburgh and of the Barklay Memorial Medal of the Asiatic Society of Bengal in 1925. He was Fellow of the Royal Society of Edinburgh, and the Asiatic Society of Bengal, and received the blue ribbon of science on his election as a Fellow of the Royal Society of London in 1930. He was appointed Editor of the "Fauna of British India" series in May 1928 in succession to the late Sir Arthur Shipley and since 1931 he worked as the Zoological Secretary of the Linnean Society of London.

Colonel Stephenson was a very brilliant teacher and those who had the privilege of attending his lectures will never forget the care and pains he took in making the subject of lectures really instructive and interesting to his students. He was a sincere and loyal friend and all his friends will miss him for his sound judgment and ever-ready help in all matters relating to education and more particularly to the advancement of zoology in India and later in Great Britain. His extensive circle of friends feel his untimely death as a personal bereavement and extend their sincere and heart-felt condolence to Mrs. Stephenson in her irreparable loss.

B. P.

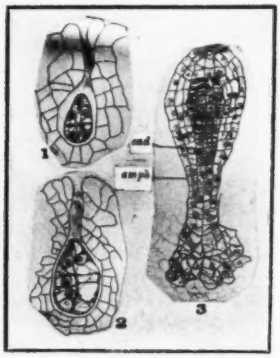
Letters to the Editor.

The Origin of the Archesporium in *Notothylas levieri* Schiff. MS.

VARIOUS authors have proposed to separate the Anthocerotales from the liverworts and place them in a class co-ordinate with the Hepaticæ. One of the main arguments advanced in support of this view has been that while in all the other liverworts the archesporium arises from the endothecium, in the Anthocerotales it comes from the amphithecium.

My examination of *N. levieri*, a common Himalayan liverwort, shows that this distinction can no longer be maintained and favours the retention of the Anthocerotales within the Hepaticæ.

The early stages in the embryogeny of *N. levieri* conform to the usual anthocerotalean type (Figs. 1, 2), but a radical difference is seen in the origin of the archesporium. Unlike the condition observed in the other anthocerotales, the archesporium here originates from the entire endothecium (end.), while the amphithecium (amph.) forms only the wall (Fig. 3).



1 and 2. × Ca 720.
3. × Ca 500.

My conclusion based on the observations of the early as well as the older stages of development of the sporogonium differs from that of Kashyap and Dutt[1] on the same species, which is based on the study of development from the meristematic zone at the base of the capsule and which is to the effect that the archesporium arises from the endothecium as well as the inner layer of the amphithecium though they do not give any figures.

A very careful study has been made by me to decide this point and an examination of numerous preparations which contain embryos at practically all the critical stages of development leaves no doubt that in this species the endothecium (end.) alone is fertile (Fig. 3).

As Kashyap and Dutt have already stated there is no columella in *N. levieri*. In *N. flabellata*, a species which also lacks a columella, the late Prof. Goebel observed that the archesporium arises from the endothecium, but whether the inner cells of the amphithecium are fertile or not he could not definitely ascertain.[2] He remarks that these cells like the endothecial cells are rich in the protoplasmic contents.[3] In the young sporogonia of *N. levieri*, also, sometimes similar amphithecial cells are seen, but a comparison with the older embryos shows that these cells never produce the archesporium. This fact suggests that *N. levieri* has been derived by reduction from a species in which the amphithecium was fertile. The columellate species of *Notothylas* would thus seem to be primitive, while those without it are reduced.

Several authors (Lang[4], Kashyap[5] and Bartlett[6]) have already emphasized that *Notothylas* shows signs of reduction in the species studied by them. In *N. indica* and *N. levieri*, too, as I have shown elsewhere[7] although the capsules usually remain enclosed within the involucre they generally open along one suture as in *Anthoceros Hallii*.[6]

S. K. PANDE.

Department of Botany,
University of Lucknow,
December 27, 1932.

[1] S. R. Kashyap, and N. L. Dutt, "Two Indian Species of the Genus *Notothylas*," *Proc. Lahore Phil. Soc.*, Sec. IV, 1925.

[2] In a recent paper (*Journ. Ind. Bot. Soc.*, **11**, 170, 1932) I wrongly stated that according to Prof. Goebel the whole of the amphithecium gives rise to the wall.

[3] K. Goebel, *Organographie der Pflanzen*, Zweiter Teil, 1915–18.

[4] W. H. Lang, *Ann. Bot.*, **21**, 201-10, 1907.

[5] S. R. Kashyap, *Liverworts of the Western Himalayas and the Punjab Plain*, Part I, 1929.

[6] E. M. Bartlett, *Ann. Bot.*, **42**, 1928.

[7] Pande, *Journ. Ind. Bot. Soc.*, **11**, 1932.

An Interesting Case of Maternal Care in an Aquatic Cockroach, *Phlebonotus pallens* Serv. (Epilamprinæ).

INSTANCES of maternal care are rarely met with outside the order Hymenoptera. It is, therefore, of great interest to record an example from among the cockroaches.

Shelford in his book entitled "A Naturalist in Borneo" mentioned that in the two viviparous species of cockroaches, namely, *Pseudophoraspis nebulosa* and *Phlebonotus pallens*, the newly hatched nymphs swarm on to the body of the mother and cling there.

On the 12th June 1929, I collected a female specimen of *Phlebonotus pallens* near the edge of the water channel of a small stream about six miles from Yercaud (4,500 ft.), Shevroy hills, South India. At the time of collection the specimen showed no extraordinary features and was preserved in spirit along with other aquatic fauna collected from the locality. Recently when the collected material was being sorted by my assistant, Mr. S. Rebiero, it was noticed that this cockroach had about one dozen young ones under its wings, while some were lying loose in the tube. The young ones were very securely packed under and could easily be seen through the wing covers which were now almost clear. A photograph of the specimen with some nymphs *in situ* is given in the figure.

The wing covers of the specimen were carefully displaced to ascertain if and how the nymphs were clinging to the body of the mother. All the nymphs were noticed to be quite free from the body of the mother. This also indicates that they most probably do not at this stage take any food from the mother, as is the case in some other insects. The nymphs are yellow or pale brown in colour and have patches of minute stiff dark hairs on several regions of the body.

The female cockroach does not look at all bulky nor was it awkward in its movements when it was carrying the young ones. The wing covers are large and arched and together with the upper side of the abdomen which is depressed from a chamber inside which the nymphs can be carried about comfortably.

In view of the fact that cockroaches have numerous enemies, the habit of carrying the young ones in the fashion described above appears to be a very efficient safeguard for the protection of the progeny. In life, the wing covers are opaque and the young ones lying under them are so nicely packed that the human eye cannot easily detect on superficial examination that the individual is carrying so many young ones on its body. Moreover, as will be readily understood, this habit, in addition to securing the safety of the nymphs against the attacks of enemies, is very useful for dispersing the species.

I am very thankful to Dr. R. Hanitsch of Oxford, who kindly named the cockroach for me.

HEM SINGH PRUTHI.

Zoological Survey of India,
Indian Museum, Calcutta.
February 2, 1933.

An Unusual Growth Phenomenon in *Coleus barbatus* Benth.

THE Labiate member *Coleus barbatus* Benth. is quite common at high elevations up to 8,000 feet, chiefly in the sub-tropical Himalayas and is rather a hardly herbaceous plant. It grows in rocky situations and its root is tuberous which, according to Cooke,[1] is pickled and eaten by the natives.

In October 1931 (at Naini Tal) while changing pressed plants after a fortnight to fresh drying sheets, certain tiny buds were found jutting out from the region a little above (about 25 mm.) the broken end of the stem of *Coleus barbatus*. The production of buds on dry specimen, specially under such an abnormal condition as that of the plant press, aroused some interest and a close observation was, therefore, made on the very same specimen under similar conditions for a period of about four months.

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[1] *The Flora of the Presidency of Bombay*, **2**, Part II, 1906.

As a result it was found that the buds continued to grow under the herbarium-sheet and by the end of sixteen weeks each of them had attained a length of about 10 mm. They were, however, vegetative in character. On dissecting one of them out, small leaves were found arranged in the manner as in the ordinary vegetative buds. Owing to their being shaded from light under the herbarium-sheet, the buds had not developed the characteristic green coloration (see photograph). Nevertheless, when exposed to light, they turned green.

Coleus barbatus: The herbarium specimen showing lax central inflorescence and the white vegetative buds (in the black square). × 1/10.

At the same time, it might be mentioned here that the central inflorescence, at the outset, was compact with open flowers. But during the four months that the observations were continued, it was found that the inflorescence-axis also kept on elongating, thus making the whole inflorescence lax (see photograph). The increase in length measured 26 mm. There was, however, no such change observed in the lateral younger inflorescences in which the flower buds had not opened at all.

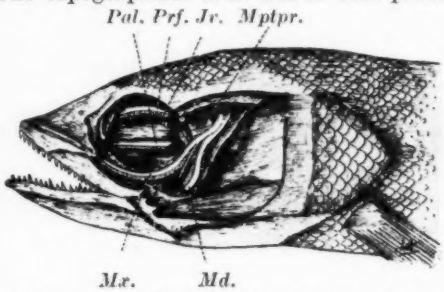
This peculiar behaviour of *Coleus barbatus* is really interesting as it demonstrates the enormous power of endurance of the plant even under the most unfavourable conditions of the plant press with great pressure and lack of water and light.

T. C. N. SINGH.

Department of Botany,
Ravenshaw College,
Cuttack.

The "Metapterygoid Process" in the Skull of *Ophiocephalus striatus*.

ONE of the few interesting cranial features of *Ophiocephalus striatus* is the presence of a flat, prominent metapterygoid process. The palatoquadrate bar articulates with the cranium not only by the palatine in front and through the hyomandibular behind, but also by the metapterygoid process, immediately behind the orbit and in front of the Trigeminofacialis chamber. The upper edge of the process is incompletely ossified. A careful study of this structure in other animals clearly shows that the metapterygoid process is homologous with the "Processus ascendens" of Dipnoi and Tetrapoda. The topographical relations of this process



Dissection of the head of *Ophiocephalus striatus* to show the "metapterygoid process" and its relationship with the neighbouring blood vessels and nerves.

Jv.—Jugular vein. *Mx.*—Maxillary branch of the V nerve. *Md.*—Mandibular branch of the V nerve. *Mptpr.*—Metapterygoid process. *Pal.*—Palatine branch of the VII nerve. *Prf.*—Profundus branch of the V nerve.

and the processus ascendens with the nerves and blood vessels are identical. The profundus branch of the V nerve and the jugular vein (*vena capitis lateralis*) pass on the inner side of the metapterygoid process, while the maxillary and the mandibular branches of the Trigeminal pass on its outer side. This feature of the pterygoquadrate bar has not been so far described among any of the Teleostomi.[1] A complete comparative account of the skulls of various members of the family *Ophiocephalidæ* and *Cyprinidæ* (chiefly *Labeo*, *Catla*, *Cirrhina*, etc.) will be shortly published elsewhere.

B. S. BHIMACHAR.

Department of Zoology,
Bangalore,
January 28, 1933.

[1] E. S. Goodrich, *Studies on the Structure and Development of Vertebrates*, p. 413, London, 1930.

Total Efficiencies of Soft X-Ray Excitation and Secondary Electron Emission from Metal Faces.

A LARGE amount of experimental work[1] has been done on the emission of secondary electrons from metal faces due to bombardment by a stream of primary electrons, accelerated by applied potentials less than about 500 volts. However, investigators of this phenomenon have always confined themselves to the measurement of the ratio of the secondary to the primary current as a function of the applied potential and to the observation of critical potentials at which this ratio showed sudden changes. It has recently been shown by me[2] that this ratio for any potential in the case of a given metal is structure sensitive.

Farnsworth[3] has studied the velocity distribution of the secondary electrons by the method of retarding potentials. Since the translational energy of an electron is proportional to the potential to which it is subjected, we can show easily that if f_1 is the fraction in the secondary beam having a velocity V_1, the efficiency of the secondary emission is $f_1 V_1/V$ where V is primary potential. Such efficiencies calculated from Farnsworth's curves for Cu, Fe, Ni and Ag, show generally an initial rise till about 10 volts and then a gradual decrease. This decrease at relatively higher potentials is strikingly similar to the decrease observed in the efficiency of soft X-ray excitation by Richardson and Robertson[4]. Similar experiments by me on polycrystalline and 100 faces of Ni show that the efficiencies are equal in both cases though the ratios of the secondary to the primary current are different at any potential.

This similarity in the secondary electron emission and soft X-ray excitation gains significance from the experimental investigations of Rudberg[5], who finds a large number of slow electrons (having less than 10 volts energy) in both the cases. This fact helps us to account for the observed saturation tendencies in the soft X-ray total intensity curves obtained by Richardson and Robertson[6] and Nakaya[7]. It is obvious that the absorption of the low velocity photoelectrons becomes rapidly more important as the depth of penetration of the soft X-rays is increased by increasing its hardness.[8] Assuming with Richardson and Chalklin[9] that the number of photoelectrons n_0 produced in the medium of the photoelectric plate by the soft X-radiation at an applied potential V, is proportional to this potential and that the depth of penetration is proportional to the average energy of the soft X-ray quantum, we obtain for n the number of photoelectrons leaving the target the expression

$$n_0 \epsilon^{-\beta V} \text{ or } \alpha\, V \epsilon^{-\beta V}$$

Nakaya's results agree very satisfactorily with this expression.

Full details of this letter will appear in two papers, one in the *Proceedings of the Royal Society* and the other in the *Journal of the Annamalai University*.

S. RAMACHANDRA RAO.

Annamalai University,
Annamalainagar,
February 14, 1933.

Engystomatid Tadpoles.

THE usual diagnosis for distinguishing the tadpoles of the families Ranidæ, Bufinidæ and Engystomatidæ[10, 11] is that those of the two former possess rows of larval teeth and horny jaws and those of the latter possess none. In fact the provisional dental characteristics and the shape, size and colour of the jaws of the tadpoles have been used for identifying the adult anura.[12] In examining recently sections of the larvæ of *Cacopus systoma* I noticed that teeth do occur, though there is a total absence of the teeth in the tadpoles of *Microhyla* and *Kaloula*. I understand that the teeth which are used for taxonomic

[1] For details and previous work, see S. R. Rao, *Proc. Roy. Soc.*, **A 128,** 41, 1930.

[2] S. R. Rao, *Proc. Roy. Soc.*, **A 128,** 57, 1930.

[3] H. E. Farnsworth, *Phys. Rev.*, **31,** 405, 1928.

[4] O. W. Richardson and F. S. Robertson, *Proc. Roy. Soc.*, **A 115,** 280, 1927.

[5] E. Rudberg, *K. Sv. Vet. Handl.*, **7,** 1, 1929: *Proc. Roy. Soc.*, **A 127,** 111, 1930.

[6] O. W. Richardson and F. S. Robertson, *Proc. Roy. Soc.*, **A 124,** 188, 1929.

[7] U. Nakaya, *Proc. Roy. Soc.*, **A 124,** 616, 1929.

[8] S. R. Rao, *Phy. Rev.*, **41,** 374, 1932.

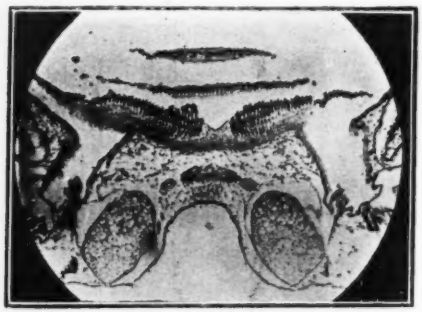
[9] Richardson and Chalklin, *Proc. Roy. Soc.*, **A 110,** 273, 1926.

[10] N. Annandale and C. R. Narayana Rao, *Rec. Ind. Mus.*, **15,** Part I, No. 3, 1918.

[11] N. Annandale, *Memoirs As. Soc. Bengal*, **6,** 118, 1917.

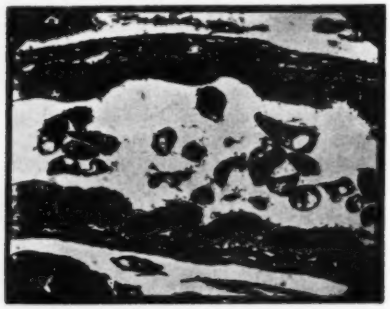
[12] C. R. Narayana Rao, *Rec. Ind. Mus.*, **15,** Part I, No. 4, 1918.

purposes will not be a safe guide in the case of Engystomatidæ, in which the character, shape and position of the spiracle, the tail fin, the caudal flagellum and relative proportions of the body are more generally relied upon for diagnosis. The question arises whether the horny teeth of the tadpoles of *Cacopus systoma* represent an arrested stage of development or whether they are vestigial remnants in the process of disappearance. The latter seems the more probable view.



Transverse section of a 20 mm. tadpole of *Cacopus systoma* showing three rows of larval teeth.

If the tadpoles of Cacopus are examined under the microscope it is easy to detect a horny rim investing the free margin of the lips and the teeth occur in various stages of growth, forming minute irregular rows which sections of the oral cavity reveal. All the Engystomatid tadpoles occur almost as a rule on the surface of the tanks and rain



Longitudinal section of the intestine showing the contents.

puddles away from the water margins and are exclusively surface feeders. On the other hand, those of the Ranid and Bufonid families frequent water margins where there is a dense vegetation. Observations made on their feeding habits both in nature and in the laboratory tanks show that the tadpoles of these two families rasp the succulent vegetation, pieces of meat and do not hesitate to develop cannibalistic propensities. Sections of the intestines of the tadpoles of Engystomatidæ show the occurrence of a large variety of micro-organisms, like diatoms, protozoa, rotifera and copepoda. They have never been noticed to nibble vegetation or meat and are easily victimised by the stronger and more predaceous Ranid tadpoles. This habit of passively imbibing the micro-organisms must account for the rapid disappearance of the provisional teeth which in *Cacopus systoma* are therefore vestigial and in the process of disappearance. In the tadpoles of *Microhyla* and *Kaloula*, they have completely disappeared.

I reproduce above the microphotographs of the sections of the intestine of the tadpole and of the buccal region of *Cacopus systoma*.

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February 20, 1933.

Amphiboles in the Bababudan Iron Ores.

IN accounting for the origin of the banded iron ore rocks of the Bababudan area, it has been suggested[1] that they are derived from the decomposition of original schists rich in highly ferruginous amphiboles like cummingtonite and bababudanite—which are sometimes seen in the ferruginous quartzites. An obvious difficulty in accepting this explanation has been to account for what has happened to the large amount of magnesia (Bababudanite—12·11%; Cummingtonite—18·68%)[2] which must necessarily have been found associated with the iron, constituting the original amphiboles.

In the course of a recent detailed examination of several sections of the Bababudan range, a remarkable fact has been noticed that the occurrence of these minerals, *viz.*, cummingtonite and bababudanite, in the iron ore rocks, is confined to narrow zones

[1] W. F. Smeeth, "Notes on a Variety of Riebeckite (Bababudanite) and on Cummingtonite from the Mysore State," *Rec. Mys. Geol. Dept.*, **9**, pp. 86, 87.
P. Sampat Iyengar, "Report on the Geology of Parts of Hassan and Kadur Districts," *ibid.*, p. 73.

[2] W. F. Smeeth, *op. cit.*, pp. 90, 91.

always at the contact of the intrusive trap rocks of the area. This, together with the fact that these amphiboles occur as acicular and lath-shaped crystals—as a rule fresh and glistening—and that when their present distribution in the rock is carefully examined, these acicular crystals are seen running right across the bands in the original rock, seems definitely to suggest that they may be only later minerals developed at the intrusive contacts of the traps with the iron ore rocks and have, therefore, little or nothing to do with the origin of the latter.

The probable mode of origin of the iron ore rocks is receiving our attention and a detailed account of the nature of the bandings in the hematite quartzites together with the chemical and optical characters of the contact minerals will be published elsewhere.

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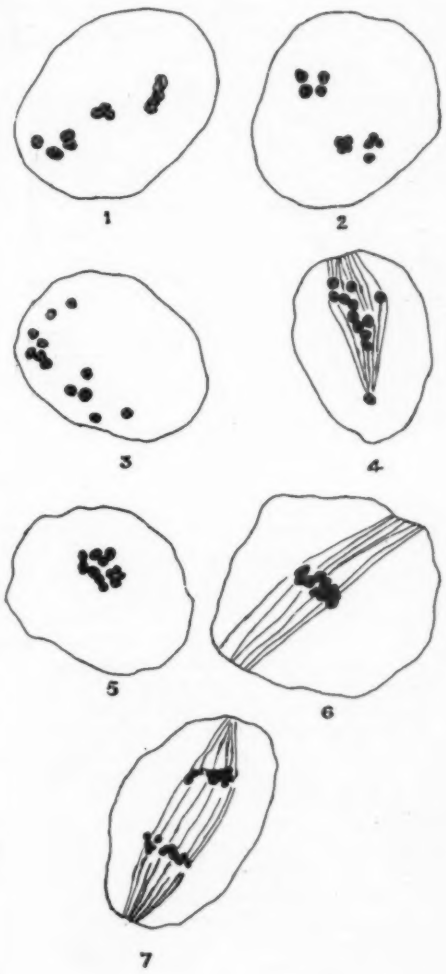
Haploid Plant in Rice (*Oryza sativa*).

HAPLOIDY among seed plants is of very rare occurrence, and the stray cases recorded in a few genera have arisen in hybridization where, due to failure of fertilization, the embryo under stimulus has developed with one set of haploid chromosomes only. There have been only two recorded instances of this phenomenon in cereals. Gaines and Aase (1926) observed among the F_1s of an intergeneric cross (*Triticum compactum* × *Aegilops cylindrica*), a haploid wheat and described its sporogenesis. Recently Morinaga and Fukushima (1931) discovered a haploid rice plant, among the F_1 progenies of a cross between a dwarf and a normal variety of rice. They were able to identify its haploid nature only by the examination of its somatic chromosomes in root tips, as the observation was made too late to study the sporogenesis of the plant.

At the Paddy Breeding Station, Coimbatore, the study of polyembryony in rice has been in progress for some time. In one of the pure lines, some seeds, approximately in the proportion of 1 : 1000, were seen to give rise to two seedlings. A large number of these twins had been planted out separately and in all the cases except one mentioned below, the twins proved identical. In this exceptional case while one of the twins was normal, the other was found slightly dwarfed, flowering later than the normal, with a poor emergence and smaller spikelets with complete absence of anthesis. Examination of this plant at sporogenesis revealed twelve univalent chromosomes distributed irregularly (Figs. 1 & 3) in the



nuclear area and later assorting at random at the two poles with the absence of the usual metaphase stages. Only a few cases of this random distribution of chromosomes are figured (Figs. 2 & 4). This irregular distribution of univalents and their random assortment at the poles is in marked

contrast to the normal heterotypic division in the normal plant where the metaphase and the anaphase stages are characteristically regular (Figs. 5 to 7). The peculiar behaviour of this plant at sporogenesis is similar to that reported of haploids in other plants. It is suggested that this haploid might probably have arisen from one of the cells of the female gametophyte. Detailed cytology of this plant is under investigation and will form the subject of a separate article.

Reference to Figures.

(Drawn with the aid of a Camera Lucida at stage level × 1500).

Figures 1 to 4 .. Haploid.
Figures 5 to 7 .. Diploid.

Reference to Literature.

Gaines and Aase (1926). *Amer. Jour. Bot.*, **13**, 373-385.

Morinaga and Fukushima (1931). *Jap. Jour. Bot.*, **6**, Abs. p. 13.

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Helminth Parasites from Certain Fresh-Water Fishes of India.

DURING the course of our investigation on the life-history, economic importance and bionomics of the fresh-water fishes of the Nizam's Dominions, we came across the following parasites in several species of the fishes obtained from the local rivers, *viz.*,

(*a*) *Philometra* sp. (♀), one half of which was pink and the other half whitish in colour, was obtained from a siluroid fish, *Wallago attu*.

(*b*) *Eustrongylides larvæ*, usually purple in colour, were obtained from *Ophiocephalus striatus*, *O. marulius* and *O. punctatus*, *Gobius giuris* and *Mastacembelus armatus*.

(*c*) Specimens of *Isoparorchis hypselobagri* (Billet) were obtained from all the species of fishes mentioned in (*a*) and (*b*) and in addition, from *Ophiocephalus gachua* and *Callichrous malabaricus*. The worms are especially very abundant in the gas-bladder of *Wallago attu*.

(*d*) One form possibly *spirurid larva* (?) has been obtained from *Saccobranchus fossilis*. In this fish another interesting form of parasitic worm has also been discovered which will be described later on.

(*e*) *Contracæcum larvæ* have also been obtained from *Ophiocephalus punctatus*.

It is interesting to note that these parasitic worms are of very wide distribution amongst the fresh-water fishes of India,—most of the Siluroids and Ophiocephalids are predaceous in their habits and either their cannibalistic instincts or their habit of one species preying upon another species that accounts for such a wide prevalence of worms amongst the piscine fauna. It is likely that the adult forms of most of these worms will be ultimately found in fish-eating birds, or some aquatic animals, *e.g.*, predatory fishes, certain reptiles, mammals, etc., the infection may even extend to man as well. Their mode of "anchoring" presents some interesting variations in different species of fishes: some are attached to the mesentery, either lying free, or in an encysted condition, while others bore their way through the muscles of body-wall, and there they may be quite free, or form cysts which appear blackish, not unlike masses of disorganized blood-clots and in certain cases they may even perforate the outer skin of the fish. Further work covering a wider field of the fish-fauna of this State is going on at present in this laboratory, and our results will be published elsewhere. We are aware of certain cestode and tremetode parasites already described by others, infesting a few fresh-water fishes of India.

Here we wish to express our great indebtedness to Dr. H. A. Baylis of the British Museum and Mr. G. D. Bhalerao, Helminthologist, Imperial Institute of Veterinary Research, Muktesar (U. P.) for the correct identification of the worms mentioned above.

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The Industrial Outlook.

[NOTES ON THE ELECTRIC RAILWAYS IN BOMBAY AND MADRAS.]

By Dr. Ram Prasad.

THE steam locomotive, although highly improved in recent years, has got its own limitations as regards efficiency, tractive effort and speed. The application of electricity for traction has proved its superiority over the steam drive in the above respects and the railways all over the world are electrifying their railroads utilizing either economical hydro-electric power or steam electric power from large central stations. Not only the suburban lines near big cities, but also the main lines radiating from centres of trade, commerce and industry have greatly benefitted by the conversion into electric drive. In Switzerland where there are no coal fields, almost the entire railway system has been electrified as the country is rich in water power. In recent years the railways in India have been carefully considering the change into electric drive and the schemes carried out by the G.I.P., B.B. & C.I., and the S.I. Railways, have proved the superiority of the electrified systems to such an extent that other railways will follow suit in due course.

The heavy suburban traffic of Bombay, a city of nearly 1¼ million inhabitants, and the important long distance passenger and goods traffic especially over the Ghat sections, where the elevation suddenly rises up to 2000 ft. above sea level with gradients of 1 in 37, constitute conditions that are very favourable for electric drive especially as power was available from hydro-electric power stations nearby. The B.B. & C.I. Railways have electrified their suburban section between Bombay and Borivli (30 miles) and the G.I.P. Railway have electrified not only their suburban sections between Bombay and Kalyan (30 miles) but also their main lines from Kalyan to Poona on the South-East and to Igatpuri on the North-East.

The South Indian Railway have electrified their suburban section from Madras Beach to Tambaram (18½ miles) and are also contemplating main line schemes to be taken up in the near future.

The suburban schemes of the G.I.P. and B.B. & C.I. Railways are both on the broad gauge and are similar in design and equipment of sub-stations including rotary converters, etc. The suburban scheme of the S.I. Railway is on the metre gauge and their sub-stations are equipped with mercury arc rectifiers instead of rotary converters. The main line scheme of the G.I.P. Railway is an extension of their suburban system, but the traction is carried on by suitable passenger and goods locomotives, the latter equipped with regenerative braking for service over the Western Ghats between Kalyan and Poona and Igatpuri.

The following is an abstract of the technical features of the G.I.P. Railway:—

1. Capital Expenditure—	
Suburban Scheme	Rs. 2·74 crores
Main line Scheme	Rs. 6·50 ,,
2. Route mileage of track electrified	181 miles
Length of single track electrified including sidings ..	571 ,,
3. Number of Suburban motor coaches	53
Number of Passenger locomotives	24
Number of Freight locomotives	41
4. Aggregate HP of Passenger locomotives	31,990
Aggregate HP of Freight locomotives	1,06,600
5. Number of sub-stations ..	15
Aggregate capacity of sub-station plant	1,00,000 Kw.
6. Steam Power Plant and equipment	4 alternations of 10,000 Kw. each. 6 Boilers of 60,000 lb. steam per hour each.
7. Length of 100,000 volts Transmission line	272 miles.

The suburban system of the G.I.P. Railway was electrified by 1925 and the main lines by 1929. The traction is of the 1,500 volt D.C. system, power being derived through rotary converters in the various sub-stations. Four of the sub-stations receive their power from the Tata Hydro-Electric Companies, at 22,000 volts from the Tata stations at Dharavi and Kalyan. The other sub-stations which feed the main lines from Kalyan to Poona and Igatpuri are fed from the G.I.P. Railway steam electric plant situated near Kalyan, through extra high tension lines at 95,000 volts which run mostly parallel to the railway lines. The wisdom of having installed a steam power plant, when there was sufficient hydro-electric power available

nearby has been questioned. The railway authorities seem to justify the steam plant and say that at the time of negotiations with the Tata Companies, conditions being adverse, there were doubts if they could guarantee priority of supply in the event of shortage of water following a bad monsoon and consequently continuity of service was not certain. In any case if conditions have improved since, it would be economical to draw more power from the Tata Companies and conserve their coal for places where the electrification has not been extended, especially as the railway power plant is so designed as to inter-link with the Tata network.

The steam power plant is designed for pulverised coal and is equipped with 6 boilers each of 60,000 lbs. per hr. steam output and 4 turbo alternators each having an economical and continuous maximum rated output of 10,000 Kw at 6,600 volts with an overload capacity of 20% for 2 hrs. and 65% for 2 minutes. Each generator is connected through an oil circuit breaker to the low tension side of its own 11,000 KVA 95,000 volts step-up transformer and also to the high tension side of its own 1800 KVA unit transformer which feeds the auxiliaries connected with that set. In all the G.I.P. sub-stations the converting plant consists of suitable transformers and rotary converter sets each comprising two 750 volts 1,250 Kw machines in series to give a 1,500 volts D.C. supply. In three of the sub-stations, all switchgear including that for starting, synchronising and connection to the busbar are designed for manual operation, and in others there is automatic operation, *i.e.*, each rotary converter is automatically started, synchronised, and connected to the busbars following the closing of a low voltage control switch. Six of the sub-stations on the main lines are unattended and fitted for supervisory control from the neighbouring attendant sub-stations. All the rotary converter sets and their switchgear are designed for receiving power from the 1,500 volts D.C. line, from the locomotives regenerating as well as for normal operation. A portion of the regenerated energy is absorbed by ascending trains up the ghats and the remainder is converted into alternating current in the sub-stations and delivered to the transmission lines. On the average about $4\frac{1}{2}\%$ of the input to the rotary converters is returned to the transmission lines. Taking the total input as 6,00,00,000 Kw. hrs. per annum, the energy returned to the high tension lines would be 27,00,000 Kw. hrs. per annum. This saving is ample to pay the capital charges on the extra cost of equipping the freight locomotives with exciters and additional switchgear for regeneration, a further advantage being the reduction in brake block renewals.

The locomotives have been designed to meet the exacting conditions of varying temperatures from 40° F. min. to 130° F. max. and the heavy monsoons near Bombay. For the suburban service each train unit consists of one motor coach and three trailers, the normal train during rush hours being made up of 2 units. Seating capacity of each unit is I class 15, II class 42, and III class 384. The motor is of 275 HP and the weight of the four-coach unit is 218 tons, *i.e.*, 5 HP per ton of train. The freight locomotives are designed with the wheel arrangement comprising of 2 sets of 3 coupled axles, so that there is less tendency to skidding of wheels and no chance of breaking of coupling when starting up the 1 in 37 gradients and running away in down grade. They are equipped with 4 motors each of 650 HP 1,500 volts rather than 6 of 750 volts so that a lower crawling speed is possible. Further they are equipped with axle driven generators for regenerative working when the locomotives are hauling trains down the ghats. The complete electrical equipment is easily and conveniently divided into 2 groups so that in the event of any electrical failures one group can be immediately isolated without affecting the operation of the other thus reducing the possibility of a train being stalled and blocking the road. All the auxiliaries, such as vacuum pumps and compressors, are in duplicate and a 50 volts battery is installed with sufficient capacity to give 4 hours supply for lights and control circuits.

The passenger locomotives for the main lines were designed to meet the growing demand of traffic with improvement in the timing between Poona and Bombay. They have a tractive effort of 7,500 lbs. at 70 miles per hour and can maintain a speed of 57 miles per hour up a gradient of 1 in 150. These locomotives have to work in combination with a freight locomotive while going up the ghats and should share the load properly at the speed desired, that is, of the total tractive effort of 40,000 lbs. required, the passenger locomotive should be responsible for 16,000 lbs. leaving 24,000 lbs. for the freight engine, both running at a speed of

about 30 miles per hour. Similarly, the locomotives have to run in combination under regenerative control down the ghats. The motor equipment of the passenger locomotive consists of six motors of 750 volts with two groups of control apparatus and all safety devices. It is remarkable that 41 freight locomotives and 24 passenger locomotives have efficiently replaced 171 steam locomotives including 96 ghat engines.

The G.I.P. Railway main line electrification scheme is the largest and the most comprehensive in the British Empire, with perhaps the recently electrified Southern Railways between London and Brighton coming next. The combined G.I.P. and B.B. & C.I. suburban electrification schemes have helped Bombay to successfully overcome the housing problem and develop the suburbs till now considered impracticable.

THE SOUTH INDIAN RAILWAY ELECTRIFICATION—MADRAS.

The S.I. Railway have adopted the 1,500 volts D.C. system very similar to the traction system of the Bombay Electric Railways, but the track is of metre gauge and the scheme is of special interest in that it was not merely the conversion of existing steam-operated lines to electrical working, but included the construction of new tracks and stations to accommodate suburban traffic between Madras and Tambaram, that had increased so much as to impede the main line services. Another novel feature is that the 1,500 volts D.C. supply is obtained by means of 1,500 volts 1,500 Kw mercury arc rectifier sets instead of rotary converters used in Bombay. Power is obtained from the steam power plant of the Madras Electric Supply Corporation at 33,000 volts and is supplied to the mercury arc rectifiers through suitable transformers and switching apparatus which are designed for automatic operation. These rectifiers can take 100% short time overloads easily.

The service on this system was opened in April 1931 and has been working quite satisfactorily. The traffic has tremendously increased with better speed and comfort and has electrification scheme. A new double track for the electric trains has been constructed from Madras to Tambaram (18½ miles) and certain shunting yards near Madras have been electrified so that shunting operations and freight services can be carried out with electric locomotives. There are two rectifier sub-stations, one at Egmore and the other at Meenambakam, with the car sheds located at Tambaram.

There are 17 articulated coach units, each consisting of one motor coach and 2 trailer coaches; 4 locomotives and 2 battery tenders. The articulated motor coach units are arranged for multiple unit working, so that trains may be made up with 3, 6 or 9 coaches according to the traffic requirements. The electrified equipment has been designed to give an average speed of 40 miles per hour with a fully loaded train over the whole distance with station stops at an average interval of 1½ miles. A three-coach unit is carried on 4 bogies and the power equipment consists of 4 motors of 122 HP each, connected permanently in pairs in series, one pair being mounted on each of the two intermediate bogies. The motors are of self-ventilated type, but owing to the excessively dusty conditions the ventilating air is drawn from inside the coach through ducts and sliding flexible joints. Power control is on the all-electric can shaft system similar to that in use on the G.I.P. Railway, and the whole of the control equipment is housed in a compartment at one end of the centre coach, which also contains a 4 Kw 1,500/60 volts motor generator set for supplying the control and lighting circuits, and exhauster driven by a 1,500 volts motor. An emergency battery is also provided, which is charged automatically and floats across the terminals of the motor generator set. Ten of the train units contain I, II, III class and seven contain entirely III class. The weight of a unit is 73 tons. The 4 locomotives are fitted with articulated bogies each equipped with two nose suspended axle-hung motor rated at 160 HP. As in the case of the motor coaches, the ventilating air is drawn from the interior of the vehicle which in turn has air inlets fitted with filters. The superstructure is of the box cab type with the control equipment mounted in a centre compartment, with a driving position at each end. The electrical equipment of the locomotives is generally similar to that of the motor coaches with the exception that it is not arranged for multiple unit operation, and 3 running positions are provided in series and also in parallel by means of weakened field notches. The locomotives are capable of hauling 500 ton freight trains or 250 ton passenger trains at a speed of from 25 to 40 miles per hour. They are 32 ft. long over buffers, 8½ ft. wide with a weight of 42 tons. Braking of the units is by

compressed air, but vacuum brakegear is fitted in addition, to suit the existing rolling stock.

One of the chief difficulties encountered in laying out this electrification scheme was the fact that there were a number of small yards at some distance from the main line which could not conveniently be provided with overhead construction although at the same time it was extremely undesirable to have to provide a steam locomotive whenever movement had to be carried out at these yards.

The problem was solved by providing in addition to the locomotives two battery tenders equipped with heavy duty batteries capable of supplying power to the locomotives at 440 volts. When a locomotive is required for service of the kind indicated one of these tenders is attached to it and after the limit of overhead construction has been reached the pantograph is lowered and by changing over a single switch the locomotive runs on the 440 volts supply from the battery. These tenders which weigh only 21 tons have a capacity of 158 Kw hrs. at the 5 hr. rate of discharge of the battery and they are equipped with a complete charging switchboard and other auxiliaries.

The South Indian Railway have not only built new type of stations to handle the suburban traffic on the electric trains, but have done away with all the level crossings in Madras City which has improved the main roads and relieved the traffic congestion. When the hydro-electric power of Pykara is available for the South Indian Railway, they may take up the electrification of the main lines near Coimbatore, Madura and Trichinopoly and also the mountain railway up the Nilgiris.

The Government of Mysore are also investigating the electrification scheme for the Nanjangud-Mysore-Bangalore system. Electric power is available at every railway station on the line between Nanjangud and Bangalore, in addition to the 35,000 volt sub-stations at Bangalore, Closepet, Chennapatna and Mysore. The scheme as worked out by the South Indian Railway for their metre gauge lines with mercury arc rectifiers seems adaptable with advantage for the Mysore Railways. Unlike Madras and Bombay, Mysore cannot buy cheap seaborne coal, is located far away from Indian coalfields and is compelled to pay very high rates for the coal required for their locomotives. Both the Mysore Railways and Cauvery Hydro-Electric Power schemes are owned by the State which helps a great deal in the economy of the electrification. The approximate cost of electrification may be in the neighbourhood of 18 to 20 lakhs. With a guarantee of power supply from the Cauvery Power Station at Sivasamudram and prospects of saving money going out of Mysore to the extent of the cost of coal purchased from outside the State, the electrification scheme deserves very careful consideration so that the details will be worked out at an early stage and the conversion to electric drive may be taken up with advantage.

The Railways which radiate from Calcutta are also considering suburban electrification as a first step which may later lead to main line electrification. Unlike Bombay, Calcutta is situated very near the largest coalfields in India, and it is possible to generate power economically in large central stations with steam power even though there are no big hydro-electric power stations nearby. The ordinary steam locomotive has to carry its own raw materials, such as coal and water, and use them in a boiler whose efficiency is far below that of large modern pulverised coalfield boilers and drive an engine whose efficiency is much lower than that of the central station steam turbines. The logical procedure is to generate power economically at a suitable steam or hydro-electric power station and distribute the energy to hundreds of locomotives with minimum of loss. The first step in nation-building is the conservation and proper development of the natural resources, and electrification plays a very important part.

Traction on the D.C. system is one phase of development, as there are several railways running on A.C. systems using single phase or three phase supply. The mercury arc rectifier which has just come into the field of D.C. traction has various modifications, which make it useful in converting power from 3 phase A.C. systems to single phase A.C. or *vice versa*. Recent investigations have shown that the mercury arc rectifier will play a very important part in the future electrification schemes as it is capable of heavy overloads and adapts itself easily for automatic operation.

A Bureau of Mycology for India.

IN his Presidential Address to the Botanical Section of the Indian Science Congress last year, Dr. H. Chaudhuri advocated the establishment of a Bureau of Mycology in India and this suggestion is repeated by him on p. 180 of *Current Science* for December, 1932, where it is said that it has been expanded in the *Madras Journal of Agriculture* to include Entomology in a combined Bureau to cover both subjects.

The primary functions of such a Bureau would naturally be (1) to serve as a clearing house for the collection and dissemination of information and (2) to organize a system for the prompt identification of injurious fungi and insects. Subsidiary functions might be (3) to arrange periodical meetings of workers interested in the subject, (4) to facilitate the "circulation" of research workers through knowledge of the work going on at different centres, (5) to facilitate the exchange of material for study, (6) to keep in touch with manufacturers (*e.g.* of apparatus or spraying materials), (7) to provide for visitors good library, herbarium and museum facilities for consultative purposes, and (8) if possible to undertake the systematic revision of groups of organisms of economic importance where such revision is called for.

Experience has shown that the function (1) above is best fulfilled by the publication of abstracts of current literature, the formation of card indexes of past and present literature on specific subjects, and the answering of enquiries by correspondence. The maintenance of a lending library, where possible, is also useful. (2), (3) and (4) require no comment. (5) can best be met not so much from the immediate resources of the Bureau as by being able to make use of sources of supply that may be scattered throughout the world. This applies particularly to cultures and preserved specimens. (6) and (7) require no comment. (8) is necessary at times because it may be impossible to fulfil function (2) adequately without such a revision.

It will be seen that there is no need to duplicate (1) provided that it is adequately carried out somewhere else and the information conveyed in a suitable language. Both in Entomology and Mycology the existing organizations provide fully for all reasonable needs of English-speaking countries. None of the Dominions nor, indeed, any foreign country has found it necessary to set up similar organizations and there is no need for a separate Indian one. (2) is in most countries provided for in national herbaria, museums, and similar institutions, and India possesses the foundations for such (so far as fungi are concerned) in the Agricultural Research Institute at Pusa and the Herbarium of the Royal Botanic Gardens, Calcutta. The reason why the far-flung British Empire has needs transcending these local ones is that only at some one centre (which convenience and local facilities has dictated should, in most cases, be London) can all the scattered threads be gathered together and knowledge gradually gained of the identity of the organisms injurious to plants in many diverse regions of the globe, of their similarities and differences, and of the risks they might present if they became disseminated from one part of the world to another. Only one such centre is obviously required and it must keep in close touch with national centres in India and elsewhere. None of the other functions of a Bureau detailed above appears to require special provision in India, as they are either already sufficiently covered to meet local (as well as inter-imperial) needs or would be too costly to duplicate in any single country. (3), (4), (6) and (7) fall under the first of these considerations, (5) the second. In regard to this last, the collection of type cultures at Baarn in Holland and the Lister Institute in London are sufficient to meet the requirements of most workers with living fungi and the setting up of other collections is to be deprecated as liable to impair their efficiency. All other requirements of material for study from foreign or other outside sources can best be met through the agency of a central organization such as those in London. Function (8) is one that is only incidental to the work of a Bureau, but every research institution wherever situated could usefully engage in this much-needed study.

Unless, therefore, Dr. Chaudhuri has some other type of organization in view than that considered above, there would appear to be no need for separate Indian Bureau. The requirements of India are covered by the central Imperial organizations, which no local one could replace, for the reasons given above, without wholly unnecessary duplication and waste of money. The service of these central organizations is not "a

matter of grace" as Dr. Chaudhuri states. It is a service paid for in hard cash and at a far cheaper rate than could be obtained at any institution carrying on similar work in India, as it is subsidized by all parts of the Empire and each contributing country has only to pay a fraction of the total cost.

Dr. Chaudhuri's light-hearted remark that it takes months or even years to obtain a report on any material sent to the central organizations is sufficiently met by the following figures. In the two years 1930 and 1931 the average time that elapsed between the date on the forwarding letter from India and the date of the report from the Imperial Mycological Institute was 37·45 days, a period that includes the time taken in transit from India, probably for parcels about three weeks. In 1932 the average time was 47·72 days, but this difference is almost wholly accounted for by a single enquiry which took 132 days and involved a great deal of critical work.

E. G. BUTLER,
Director.

Imperial Mycological Institute,
Ferry Lane,
Kew, Surrey, England.
January 16, 1933.

* * *

THE many mycological workers in India will feel heartened by Dr. Butler's declaration that they can expect the service of his organization as a matter of right since "it is a service paid for in hard cash" and not given "as a matter of grace" as put by me through ignorance. We may perhaps now look forward to Indian mycologists being employed in Dr. Butler's Bureau, since India is paying part of the expenses.

I am very pleased to know of the prompt way in which enquiries from India are dealt with. If I complained about the delay in getting reports, it was due to my experience of the Bureau in its early days. The data now supplied by Dr. Butler, leave no doubt about the promptness with which enquiries are now attended to, and I feel certain that the Imperial Mycological Institute will now receive many more enquiries from India than before. Mycologists in India will feel indebted to Dr. Butler for this statement.

Now as regards my plea for the establishment of an Indian Bureau of Mycology, I fully agree with what Dr. Butler has said regarding the functions of a mycological bureau. Dr. Butler will no doubt grant that the Mycological Section at Pusa has been doing much of the work which he ascribes to such a bureau. If there is any duplication of the work that is being done in London, I maintain it is a necessary duplication, and every country has got to do that kind of work independently. But I would not suggest that the Indian Bureau should start publishing abstracts of mycological literature; that work is very efficiently done by the London Bureau. If, however, I am permitted I may suggest that along with the abstracts, the addresses of the authors may as well be printed. That will facilitate exchange of material direct.

My whole endeavour has been to press for the establishment of a culture bureau in India, similar to that of Baarn, where the cultures of fungi isolated here may be maintained and made available to the workers in India. The situation and climate of Pusa being unsuitable for the purpose, I suggested the establishment of a separate mycological bureau. Since the publication of my last letter, this matter has been discussed by the Imperial Council of Agricultural Research, India, and the idea accepted, and I am glad to state that efforts are now being made to find out the best way to give effect to it. Under the present financial condition the establishment of a separate bureau not being a feasible proposition, the best thing would be to develop the Mycological Section at Pusa into a proper mycological bureau. This involves refrigerating arrangements for maintaining cultures, which however need not prove an insurmountable obstruction as there is an ice-plant there which has got an output sufficient to meet the demand.

Mycological workers in India are indebted to the Mycological Section at Pusa for the help and facilities given there. If it now develops into a proper mycological bureau, and I have no doubt it shall do so soon, nobody will feel more happy, I am sure, than Dr. Butler who has been associated with it from the very beginning. There is need and scope for its development, and certainly money spent there will not be money wasted.

H. CHAUDHURI.

Punjab University,
Lahore.
February 14, 1933.

Marriage among the Ūrālis of Travancore.

By L. A. Krishna Iyer, M.A.

THE Ūrālis are a small jungle tribe found in the Peermede and Thodupuzha taluks of Travancore. Their life of isolation on the hills has kept them away from the civilizing influence of the plains with the result that they preserve most of their primitive customs and manners. It is proposed to treat here of their marriage customs.

Marriage is by exchange of sisters. No man can have a wife unless he has a sister whom he can give in exchange. An Ūrāli cannot purchase a wife from her parents by giving the equivalent in property of some kind, whether it be in goods, cattle, or money. A man who has no sister to offer in marriage has often to lead a life of single blessedness. Formerly, an Ūrāli married as many wives as he had sisters. Now a man does not marry more than two women. A number of young men remain unmarried for want of women. The scarcity of women as wives was caused in large measure by the selfish action of old men. The result is unequal distribution of women as wives between males of the community, the old men having more than the young who had to go without any. Cross-cousin marriage is also in vogue. The marriage ceremonial is very simple in form. It takes place both before and after puberty. The boy's uncle settles the marriage. The bridegroom and father go to the bride's hut and escort the bride to their hut, where the bride's party is treated to a feast. Dowry consists of bill hook, clothing and vessels.

Polygamy was widely prevalent formerly. It is now very limited. A man marries more than one woman for assisting him in his agricultural operations or for want of progeny by his first wife.

Polyandry is said to prevail where there is a surplus of men. Rev. Mateer observes that the Ūrālis practised polyandry like the Todas, but it seems to have died out. It is now observed that there are more males than females. In two hamlets there are 65 girls to 100 boys.

The system of marriage by exchange of sisters is found among the Ullādans and Malavēdans of Travancore, the Mādigas of Mysore, the Bhothiyas of United Provinces, the Garos of Assam, the Australians and other backward tribes of the world. It seems probable that this practice was at first a simple case of barter, and that it originated in a low state of savagery, when women had a high economic value as labourers, but when private property was at so rudimentary a stage that a man had no equivalent to give for a wife except another woman. The same economic motive might lead the offspring of such unions who would be cross-cousins, to marry each other, and thus the custom of cross-cousin marriage would arise and be perpetuated.

It is said that the exchange of sisters by their brothers was probably older than the exchange of daughters by their fathers, since relationship between brothers and sisters, children of the same mother, must have been well known and recognition of that relationship conferred on brothers a degree of authority which enabled them to exchange their sisters or their sisters' daughters for other women whom they either married themselves or gave in marriage to their sisters' sons.

The custom of cross-cousin marriage is considered to have arisen from exchange of women by brothers. It seems to have been the direct consequence of interchange of sisters in marriage and that the latter flowed directly from the economic necessity of paying for a wife in kind. Thus exchange of sisters co-exists with cross-cousin marriage not only among Ūrālis, the Ullādans, and the Malavēdans of Travancore, but among other tribes in other parts of the world.

A Bibliography of Zoological Work in India.

By P. W. Gideon,

Department of Biology, Karnatak College, Dharwar.

WITH a view to compiling a bibliography of the work done by zoologists in India, so as to afford a ready reference to all workers on Indian problems, I have asked through the Chairmen of the Boards of Studies in Zoology, Medicine and Agriculture of Indian Universities, all zoologists engaged in research or other work to co-operate by sending me reprints of their work published during the last five years (1928-32), and to give all information regarding the problems on which they are at present engaged.

In reply to this request reprints of publications and information regarding zoological work are coming in, and to avoid unnecessary correspondence I would like to bring to the notice of zoologists the following points:—

1. Care should be taken to mention the year and month of such publications where reprints are not sent.
2. Universities and Institutions as have been approached and are *not* engaged in any zoological work may kindly reply to that effect, as delay may be caused in waiting for their information.
3. Information of *work in preparation* is necessary, as a short review of the various centres of research with the various sections of zoology in which they are engaged, is contemplated.
4. So far the information received from the Chairmen, Boards of Studies in Zoology of a number of Universities, has dealt with the work done by the University Staff only. I should like it to be made clear that in order to compile a complete bibliography it is also necessary to have the work done by members of the Zoology Department in each college affiliated to the University.

I have also asked the various research institutions throughout India to furnish me with the same details, and would like to take this opportunity of asking private institutions and individuals engaged in zoological work to co-operate also. It would be very helpful if the necessary information could be sent in as early as possible as the work is to be completed during the long vacation, March to June 1933.

The following is a list of the Universities and research institutions I have already approached, but not included in this list there may be other institutions and individuals whose help is also solicited for a completion of the scheme.

UNIVERSITIES.—Agra, Aligarh, Allahabad, Andhra, Annamalai, Benares, Bombay, Calcutta, Dacca, Delhi, Lucknow, Madras, Mysore, Nagpur, Osmania, Patna and Punjab.

RESEARCH INSTITUTIONS.—

1. The Zoological Survey of India, Indian Museum, Calcutta.
2. The King's Institute, Guindy.
3. The School of Tropical Medicine, Calcutta.
4. The Department of Fisheries, Madras.
5. The State Research Laboratory, Rajkot.
6. The Government Museum, Madras.
7. The Prince of Wales Museum, Bombay.
8. The Imperial Council of Agricultural Research, New Delhi.
9. The Indian Central Cotton Committee, Bombay.
10. The Imperial Institute of Veterinary Research, Muktesar.
11. The Imperial Entomologist, Pusa.
12. The Locust Research Entomologist, Lyallpur.
13. The Indian Lac Research Institute, Ranchi.
14. The Central Research Institute, Kasauli.
15. The Fisheries Bureau, Chepauk, Madras.
16. The Department of Medical Services, Nova Goa.
17. The Department of Medical Services, Pondicherry.
18. The Veterinary Serum Institute, Bareilly.
19. The Colleges of Agriculture, Poona and Coimbatore.
20. The Forest Colleges, Dehra Dun and Coimbatore.
21. The Veterinary Colleges, Bombay and Madras.
22. The Medical College, Vizagapatam.

Research Notes.

On the Graptolites prepared by Holm.

OLIVER M. B. BULMAN, (*Arkiv for Zoologi*, Band 24, Hafte 2, 1932) in a series of papers makes a distinct contribution to our knowledge of Graptolites, based on the magnificent collection of 'etched' Graptolites prepared by Holm. The greater part of the material in the Holm collection was obtained from Gra Lituitkalk and the Glauconithaltig, Gra Vaginatumkalk of Oland and the Ordovician limestones. The forms described are referred to their particular stratigraphical formations and the paper is profusely illustrated with beautiful photographs and figures. The descriptions of the different genera are exhaustive and the paper forms an excellent work of reference for all students of Palæontology.

Continuous Cometary Spectrum.

THE continuous cometary spectrum has recently been attributed by Willi M. Cohn (*Astrophys. Jour.*, **76**, 277, 1932) to the bombardment of ions of different materials in the rarified tail of the comet by electrons assumed to be constantly emitted from the sun. Laboratory experiments are given which show that the cometary spectrum is unpolarised according to theory. On the other hand if the scattering is of the Tyndall type a complete polarisation is to be expected which is almost entirely absent in the violet type spectrum of comets. The appearance of CO^+ and N_2^+ bands favours the suggested origin of the spectrum and indicates that the pressure in comets may be of the order of 10^{-4} to 10^{-5} mm. of mercury. Since the electron velocity is reduced by its travel through the turbid medium of cometary matter, the theory explains also why with increasing distance from the head of the comet the maximum is shifted from 4000 to 4700 Å in the tail of the comet Morehouse.

Spraying in Coffee Production.

THE function of spraying in coffee production is the subject of two recent articles by W. W. Mayne in *The Planters' Chronicle* (**28**, 34, 53, 1933). After drawing attention to the fact that the Leaf-Disease is almost specific to coffee, the author adduces evidence to show that treatments like cultivation and manuring, though helpful to plant growth, will also, generally, favour the development of the fungus causing the disease. On the other hand, spraying eliminates the fungus and, by minimising the risk of leaf fall or destruction, it also provides the plant with an increased effective leaf area for the photosynthetic assimilation of carbon dioxide. The plant bears more flowers and fruits than it might have done in the diseased condition and thus gives a bigger yield of seed. The available evidence would also suggest that manuring, though helpful in maintaining soil fertility, does not appreciably increase crop-yields.

The author does not, however, explain how spraying leads to increased crop-production even in areas where the destructive effect of the Leaf-Disease is not perceptible. Furthermore, the effects of the sprayed chemicals both on the physiology of the plant and on the chemical composition and microflora of the soil into which it is ultimately washed down cannot be entirely ignored, particularly in the light of the literature that has been accumulating in recent years. It is known that the more progressive planters are liberal in their sprayings so that the quantities of chemicals thus applied per unit area would be considerable. It is suggested therefore that a systematic investigation directed towards the elucidation of the biochemical significance of spraying not only in the case of coffee but also in those of other plantation and horticultural crops of economic importance should be undertaken.

Kaolin Minerals from Felspar.

IN a recent number of *Journal of Geology* (**40**, No. 8) Messrs. A. E. Badger and Abde Ally have published a short note on their experimental work on the formation of kaolin minerals from felspar. Selected felspars of known composition have been subjected to attack by dilute hydrofluoric acid or carbonic acid under specific conditions of temperature and pressure, and the resulting alteration product studied by X-ray methods. The action of dilute hydrofluoric acid at about 225° C. on a potash felspar resulted in the formation of a kaolin mineral—kaolinite or dickite. The action of carbonic acid on powdered felspar did not result in the formation of any kaolin mineral. The authors consider that this

may have been due to the relatively short duration (156 hours at temperatures up to 60° C.) of these experiments.

Comparative Studies on the Physiology of the Iris.

J. Z. YOUNG (*Proc. Roy. Soc. Lond.*, **B. 112,** 776, Jan. 1933), after a comparative study of the iris muscles of different fishes, has come to certain important conclusions regarding their physiology. In Selachians of which Scyllium, Mustelus and Trygon have been chosen as examples for study, he has found that the sphincter iridis muscle is not under direct nervous control. A quite different result has been obtained in bony fishes like Lophius and Uranoscopus. The varied effects of drugs like adrenaline, acetyl choline, pilocarpine and eserine have been noted on the different muscles of the Iris.

Study of the Upper Ionised Atmosphere in Bengal.

PROF. S. K. MITRA and Rakshit have recently communicated the results of their study of the upper ionised atmosphere in Bengal by wireless echoes of short delay (*Phil. Mag.*, **15,** 20, 1933). The group retardation method as developed by Breit and Tuve has been employed with a transmitter of the type originally suggested by Appleton and Builder. From a knowledge of the time interval between the direct and reflected pulses reaching the receiver, the equivalent height of the upper F-layer has been calculated. The recording system, which is located at a distance of 3·8 km. from the transmitter, consists of a receiver and a cathode ray oscillograph. One pair of the deflecting plates of the latter are connected to the receiver output and the other to the neon tube oscillator for obtaining the linear time base. The height of the F-layer is observed to decrease gradually as the day progresses, the evening value being usually about 20% lower than the midday value. The average height of the F-layer in the afternoon is about 250 km. Multiple echoes become very conspicuous near sunset and their number increases as one moves away from the transmitter. Though no regularity in their relative intensity is noticed, the time intervals are absolutely constant thus supporting the hypothesis that echoes are caused by multiple reflection between the earth and the ionised layer.

Magnetic Properties of Wood Ashes.

E. WEDEKIND has recently investigated the magnetic properties of the ashes of a large variety of woods in the Forest Academy of Hannover Münden and his results have been published in *Naturwissenschaften*, **21,** 24, 1933. He finds that most ashes have distinct ferromagnetic properties, due probably to the presence of iron as magnetite. The magnetisibility is dependent on the strength of the magnetic field and even minute differences in the iron percentages have apparently quite a considerable influence. As all the woods that were investigated were grown on the same kind of soil, differences in the constitution of the same are eliminated. It was found that the magnetisibility decreases in the order : larch-pine-fir-Scots-fir-oak-beech-ash-alder-birch. The preparation of the ash from the wood was carried out by a uniform method and the temperature was not allowed to raise above 600°. Higher temperatures apparently decrease the magnetisibility by chemical or physical processes. The ashes, obtained thus, even show differences in the colour, etc.

It would be very interesting to find out why certain plants possess a higher absorption capacity for iron and what influence this factor has on the other properties of the wood obtained from them.

Abundance Ratios of (rare) Isotopes.

[H. Kallmann and W. Lasareff. *Zs. f. Phys.*, **80,** 237, 1933.]

BY means of some improvements effected in the mass-spectrograph (using an electrometer whose reading gives the intensity of the mass-spectrum line) the authors have determined the abundance ratio of O^{18} to be 1/630 of O^{16} while the intensity of O^{17} could not be measured. By comparison of their results in Neon with previous determinations they find that the intensity of a mass line does not depend on the conditions of discharge in their form of apparatus. This is important since there are variations of more than 100% in the intensity ratios of isotopes deduced from band spectra, due to variations in the conditions of excitation (see F. A. Jenkins & L. S. Ornstein, *Proc. Kon. Akad. Wet. Amsterdam*, **35,** 1212, 1932). Thus C^{13} : C^{12}=0·2 in stellar spectra, 0·005 in the furnace spectrum and somewhat larger in the Mecker flame and vacuum tube, but C^{13} does not at all occur in the arc. With

the new apparatus the authors find that Ne^{20}: Ne^{21}: Ne^{22}=93·7 : 1 : 9·75. They have also found traces of another isotope of mass 23 whose intensity is 1/2000 of that of Ne^{20} and they think that the corresponding mass spectrum line must be due to a new isotope and not to $Ne^{22}H$, since such compounds do not occur in other rare gases. Working with HCl they find also another chlorine isotope Cl^{39} which is 1/1920 times as intense as Cl^{37}. Using negatively charged ions they found that Cl^{39}: Cl^{37} as 1 : 1850. Hence the result. Cl^{39}: Cl^{37} : Cl^{35}=1 : 1850 : 6000. Cl^{40} did not occur; if it exists at all it is less than 1/10000 of Cl^{37}.

Optical Orientation in Felspars.

A VERY interesting paper on "Permanent changes in the optical orientation of Felspars exposed to heat" has been recently published by F. W. Barth (*Norsk Geol. Tidsskrift*, **12**, 1931) and the following new data are furnished on this subject:

"Orthoclase frequently exhibits conspicuously large changes of the optic axial angle, whereas the position of the optic indicatrix remains unchanged. It was found to be a general rule that the more potassic the felspar the bigger the change.

Microcline is *not* changed by heat treatment. Since it has been claimed that microcline, if heated long enough, will slowly invert to orthoclase, it is worthy of notice that this assertion is proved to be false.

Albite and oligoclase are very slightly changed on heating.

Labradorite exhibits appreciable alterations of both the position and shape of the optic indicatrix."

Time-Variation of Gravity.

[Tomaschek and Schaffernicht. *Ann. d. Physik*, **15**, 789, 1933.]

ACCORDING to Couvoisier the cosmic motion of the earth should result in a diurnal variation of gravity by about 6×10^{-3} of its value, *i.e.*, by about $5\cdot9\times10^{-3}$ cm./sec^2. The authors describe a gravity meter which is claimed to be capable of detecting a variation of 10^{-9} of the value of gravity. A long spiral, about 18 mm. in radius and made of Krupp's elinvar steel wire of 0·5 mm. radius, is attached to a torsion head at the top and to a small pulley at the bottom. A rod attached to the pulley along its axis carries a gilded weight of 52·5 grm. The spiral weighs 12 grm. and when stretched by a weight of 52·5 grm. its length is 110 cm. The pulley is supported partly by a bifilar suspension of phosphor bronze, 43 cms. long, attached at the ends of a diameter. The torsion head can be rotated and its position can be read correct to 20″. It is also capable of being moved up and down to within 10^{-3} mm. so that the part p of the weight balanced by the bifilar suspension can be varied. By making p small and rotating the torsion head so that the pulley is in a position of critical equilibrium, the slightest alteration of the length of the spring is made to cause a rotation of the pulley. This rotation can be detected by means of a mirror fixed to the rod which carries the weight. This weight forms part of an attracted disc electrometer and the change of weight compensated by a potential of V volts is $0\cdot945\times10^{-11}gV^2$. The whole apparatus is enclosed in an evacuated vessel and an attached barometer and thermometer indicate changes of pressure and temperature amounting to 10^{-2} mm. of mercury and $7^\circ\times10^{-1}$ respectively. Automatic records of the motion of a spot of light reflected from the mirror clearly show the daily periodic variations due to the lunar tide and to the declination of the moon, but no effect of the nature predicted by Couvoisier's theory is observed. The expected value for this effect at Marburg was $3\cdot2\times10^{-9}g$ and could have been easily detected. The authors conclude that a Lorentz contraction of the earth cannot be detected even by its gravitational effects just as it cannot be made manifest by electrodynamic experiments.

Recent Researches on Vitamins.

A SURVEY of the latest researches on vitamins is the subject of a special article in a recent issue of *Nature* (**131**, 118, 1933). After drawing attention to Prof. J. C. Drummond's useful summary of the position (*J. Roy. Soc. Arts*, **80**, 949, 959 and 983, 1932), the reviewer draws attention to the more important findings of the past few months. There is increasing evidence to show that narcotine derivatives possess no antiscorbutic properties: on the other hand, the identity of the antiscorbutic factor in lemon juice with a hexuronic acid (ascorbic acid) is gaining support. It is now generally agreed that crystalline vitamin B_1 contains sulphur: the recent observation of Guha and Chakravarty that ultra-violet irradiated

adenine sulphate possesses the properties of that vitamin would appear to bring us nearer to its synthesis than ever before. Vitamin B_2 would appear to be a neutral substance with a higher molecular weight than vitamin B_1. The preparation of a crystalline compound with vitamin B_3 activity and an empirical formula $C_4N_4H_5Cl$ has been described. Karrer and his co-workers suggest that vitamin A is an unsaturated alcohol with the empirical formula $C_{20}H_{30}O$ or $C_{22}H_{32}O$, an observation which is supported by the work of Heilbron, Drummond and their co-workers. Owing probably to the presence of substances which interfere with the development of the blue colour, the Carr-Price reaction does not yield results which are in keeping with those obtained by biological methods. The intensity of the band at 3280 Å in the whole oil appears to be a very satisfactory measure of biological activity. The mechanism of the transformation of carotene into vitamin A is still obscure: the conversion occurs, presumably, in the liver but there is no evidence to suggest that it is brought about by an enzyme. Deficiency in vitamin A leads to increased nitrogen metabolism resulting in less nitrogen being deposited in the body and more being lost by excretion than when the supply of that vitamin is adequate. The growth-promoting and anti-infective properties of vitamin A are due to its ability to maintain a normal structure in the different tissues of the organism. The isolation of crystalline vitamin D has reduced the interest in biological tests for the antirachitic vitamin. Mention should however be made of the prophylactic radiographic method of Bourdillon and Bruce, bone analysis of Hume, Pickersgill and Goffikin, and analyses of 'line' test and growth-promotion studies of Key, Cowart and Morgan. The review ends with a suggestion that a dietary survey should be carried out to determine the extent to which the various minor diseases are traceable to deficient intake of vitamins. It need hardly be added that similar surveys carried out in the different provinces of India will lead to findings of considerable practical importance.

Method of Manufacturing a Leather Substitute.

[*Ind. Pat.*, No. 18519 dated 23rd November 1932.]

THE above invention by Seiichi Yamamoto, a Japanese engineer, relates to the utilization of the bark of *Arto carpus Kunstleri* known also by the name, 'Kayutarap' in the South Sea Islands. The bark contains a very strong fibre together with 8–12 per cent tannin. The latter is removed by either extraction or spontaneous fermentation: the residue is opened in a wet condition with a roller or by beating to make a coarse network. The clean fibrous product thus obtained is pasted together with couchoc or balata dissolved in a volatile solvent with sulphur, pressed and finally steamed for vulcanization. Boards of artificial leather are thus obtained which have a pleasing appearance, are flexible, elastic, water-proof and resistant to mildew and possess at the same time, high tensile strength comparable only with leather of best quality.

There are numerous trees and shrubs in India the barks or stems of which contain fibre of the desired quality. It is not improbable that some of them may be useful for manufactures similar to those claimed in the above patent.

Science News.

Mr. K. R. Venkatasubban, Science College, Trivandrum, has sent a note in which he records a case of abnormal strobilus of Lycopodium, section Phlegmaria.

* * *

Miss Oldroyd's note on "Liverworts and Fern Sporophytes" published in *Cur. Sc.*, **1**, 7, 216, suffers from the defect that the specific name of the plant is not mentioned. Rai Bahadur Professor Shivaram Kashyap and Mr. A. C. Joshi of Benares Hindu University draw the attention of the author that the specimen she has described is *Gymnogramme leptophylla Desv.* and that the observation she has made has already been recorded by previous authors.

* * *

MR. M. KRISHNA MENON, University Zoological Laboratory, Madras, writes:—

"Larvæ of Decapod Crustaceans form an important constituent of the plankton of the Madras coast. Large numbers of them belonging to most of the families of the order were captured soon after the rains. This abundance seems to be due to the fact that the adults begin to breed as soon as the rainy season has set in. Their number falls gradually towards the close of March and in April; but in the succeeding four months which form the hottest part of the year the fall is sudden and considerable. Further, it has been noticed that the larvæ occurring in the townet collections of these months belong mostly to Anomura and Brachyura. They occur also

during the other months so that they can be considered as fairly permanent constituents of the plankton. It would seem, therefore, that these larvæ are more hardy and better fitted to endure the variations in the physical and chemical properties of sea water during different parts of the year. Several Decapod forms, however, appear only for short periods, being practically absent during the rest of the year.

These general observations were made while I was engaged in 1932 in a detailed study of the larval histories of 4 forms, *viz.*, *Acetes sp.*, *Callianassa sp.*, *Hippa asiatica* and a form belonging most probably to the sub-family *Upogebinae*. The work has now been completed and is being published in the next number of the *Madras Museum Bulletin*. Further study of other Decapod larvæ will be taken up in 1933."

* * *

Aluminium and Zinc as Water Softeners.—DR. B. S. SRIKANTAN, D.Sc., Chemical Laboratories, College of Engineering, Guindy, Madras, writes:—

"It is found that aluminium powder and also mixtures of aluminium and zinc powders when shaken with hard water render it soft. Aluminium removes only the temporary hardness in less than two hours. Plenty of evolution of carbon dioxide takes place and a white precipitate is thrown down. It is not capable of removing permanent hardness. The reaction could be represented by

$$MgO, 2CO_2, H_2O + 4Al + 3O_2 + 6H_2O \rightarrow 2Al_2O_3, 6H_2O + MgO, H_2O + 2CO_2$$

Permanent hardness due to $CaSO_4$ and $MgSO_4$ is removed by mixtures of aluminium and zinc. A mixture of *Al* and *Zn* in the ratio of 1:10 was found to be the best. Hydrogen is liberated in this case. The reaction is perhaps due to the incipient electrolytic action of the *Al-Zn* couple resulting finally in the adsorption of the SO_4-ions on the surface of these metals.

In all cases hard waters with definite amounts of bicarbonates and sulphates of calcium and magnesium dissolved in them were prepared and examined. The *Al-Zn* couple is so effective that the resulting soft water fails to give the usual test for the radicle. A few of the results are cited here.

Hardness of water due to	Degree of hardness Before	After	Softener
$Mg(HCO_3)_2$	50·5	1·2	Aluminium
$CaSO_4$	61·6	1·0	Al–Zn.
$MgSO_4$	62·5	1·5	Al–Zn.

For Laboratory tests trials were made with 10 gm. of the softener and 2 litres of hard water. Technical details are being worked out."

* * *

Gall in the Mango Fruit.—DR. T. R. SESHADRI and MR. G. SESHADRI IYENGAR, Agricultural Research Institute, Coimbatore, in the course of a communication, write:—

"Though the existence of galls in parts of the mango tree such as the stem, leaves, etc., has been frequently noticed and studied, there does not seem to be any mention in the literature about the occurrence of galls inside the mango fruit. A peculiar case of gall in the fruit was noticed in a variety called 'Neelam' fairly common in Coimbatore. It is a rather small sized fruit with a thick skin which is usually light yellow, the mesocarp also being of the same colour. It is sweet and non-fibrous. It is frequently found to be attacked by beetles and when the fruit is cut, one or more of them emerge from holes in the nut. The specimen herein described contained, however, no beetles and the nut was entire though very undersized and thin.

The gall was found to be in the form of nodules which were rather hard to eat and which filled most of the fleshy portion of the fruit. On making a hole at one end of the fruit and squeezing it, the thin nut along with a small quantity of fleshy matter come out. The gall remained inside and was found to be sticking to the skin fairly firmly.

The photomicrographs of the section of the gall reveal prominently the thickening of the cell walls and the existence of granular bodies inside the cells. From micro-chemical tests it is found that the cell walls are not made up of cellulose but that they are mostly cutinised with lignin-formation in certain of the highly thickened portions. The granules inside the cells consist of starch."

* * *

Mosquito and Charophyta.—MR. S. C. DIXIT, M.Sc., Wilson College, Bombay, writes:—

"There is a remarkable statement in the Presidential address of the Botany section of the last Science Congress published in *Current Science* (January, p. 208). It says: "It is reported that mosquito larvæ do not flourish in water in which Characeæ are growing. If this should prove to be correct, then we have another method of getting rid of the larvæ."

Recently Mr. B. P. Pal has discussed the same topic at length in his paper on Burmese Charophyta (*Linn. Soc. Jour.*, **49**, 327, p. 61). Mr. Pal says: "It is highly probable, therefore, that the supposed larvicidal properties of Charophyta are non-existent."

The writer has been working on Charophyta and his observations confirm Mr. Pal's results. Mosquito eggs are laid mostly in shallow and stagnant water irrespective of Charophyta. The problem should, therefore, be studied in relation to the depth, stagnation and the size of water-holding area.

At Santa Cruz near Bombay there are vast areas covered by Charophyta; yet this place is full of mosquitoes.

Larvicidal effect of Charophyta seems to be one of those fallacies wherein a scientist occasionally gets entangled."

* * *

At the Section of Mathematics and Physics of the last Indian Science Congress, Prof. S. K. Mitra read an interesting paper on investigations carried out at Calcutta on the ionised regions of the upper atmosphere in Bengal by wireless echo method. The results so far obtained indicate that (*a*) there are two distinct ionised regions, the so-called E- and F-layers, (*b*) there is a marked diurnal change in the heights of both these layers and in the intensities of the echoes therefrom, (*c*) the multiplicities of the echoes are most prominent during the sunset and sunrise periods, (*d*) the number and intensities of echoes increase as one moves away from the transmitter. The observations were carried out at various places within a radius of 8 km. from the transmitter, with a mobile receiver fitted up in a motor bus.

To demonstrate the observed results before a large audience, a cinematographic record of the echoes was obtained on a film. This was exhibited to illustrate the important features of the echoes. The oscillograph employed for filming was the

Cossor c-type and the camera was Zeiss kinema. The experimental portion of the work was done by Mr. H. Rakshit, M.Sc.

* * *

At the Annual General Meeting of the Indian Chemical Society, held on Tuesday, the 3rd January 1933, at Patna, the following office-bearers were elected for the year:—

President—Dr. N. R. Dhar, *Vice-Presidents*—Dr. H. E. Watson, Dr. J. N. Mukherjee, Dr. H. K. Sen, *Hon. Secretary*—Dr. P. C. Mitter, *Hon. Treasurer*—Dr. P. Neogy.

* * *

Under the auspices of the Mysore University, Prof. B. S. Madhava Rao delivered two extension lectures on "Recent Developments in Astrophysics". In the first lecture the galactic system, extragalactic systems, Shapley's recent cosmological scheme of galaxies, super-galaxies and meta-galaxies, all included under the general head of "space-time complex", were described, followed by an outline of the scheme of evolution as developed by Jeans and the theories of the origin of the solar system. In the second lecture recent theories of stellar evolution were detailed. The relation between luminosity and effective temperature leading to the importance and evolutionary significance of the Russel diagram, Eddington's pioneer work on radiative equilibrium, and the theories of Eddington, Jeans and Milne on Stellar Stability were then described. The relative merits of the three theories were argued and a strong case made out for that of Milne.

* * *

We acknowledge with thanks the receipt of the following:—

"Journal of the Indian Mathematical Society"—Vol. 19, No. 11, Oct. 1932.

"Indian Forester"—Vol. 59, Nos. 1-2.

"Chemical Age"—Vol. 28, Nos. 706-710.

"Nature"—Vol. 131, Nos. 3298-3301.

"Education in India in 1930-31."

"Scientific Indian"—Jan. 1933.

"The Nagpur Agricultural College Magazine"—Vol. 7, No. 3, Feb. 1933.

"Berichte Der Deutschen Chemischen Geselschaft," 66 Jahrg. Nos. 1-2.

"Brooklyn Botanic Garden Record"—Vol. 22, No. 1, Jan. 1933.

Report of the Indian Chemical Society for the Year 1932.

42nd Annual Report of the State College of Washington, Agricultural Experimental Station, Pullman, Washington.

"Journal of Nutrition"—Vol. I, No. 6.

"Bulletin of the U.P. Academy of Sciences"—Vol. 2, No. 2.

Reviews.

THEORY OF HEAT. By Prof. Max Planck (translated by Prof. H. L. Brose), pp. viii+301. London: Macmilian & Co., Ltd., 1932. Price 12*sh*.

The book under review forms the last of the five volumes on theoretical Physics by Prof. Max Planck, the distinguished originator of the quantum theory. The great merit of the work lies in assigning in the scheme of physical thought a proper place to the science of heat in which the laws of Newtonian mechanics were found for the first time to give way to the principles of quantum dynamics. The book is entirely theoretical and makes no claim to deal with experimental physics. The exposition throughout the book is very lucid and masterly which is characteristic of Prof. Planck's writings.

The book is divided into four parts dealing with thermodynamics, conduction of heat, radiation, statistical mechanics and the theory of quanta.

The treatment of the subject of thermodynamics closely follows the plan adopted by the author in his well-known treatise on Thermodynamics which has been widely appreciated by scholars and is almost a classic on the subject. The narration and deduction of formulæ are nearly identical with that of the other treatise and the reader readily perceives the similarity on a casual glance of the book. Some less important portions not directly connected with heat have been omitted, while at some other places the treatment has been slightly condensed without in any way impairing the lucidity and the logic of the exposition. The argument has at few places been modified as in the proof of the principle of increase of entropy (pp. 63-65) which is preceded by an exposition of the nature of the temperature and entropy functions.

Part II begins with a discussion of the application of the laws of thermodynamics to the theory of heat conduction. It is interesting to find the application of the second law to this subject, but one would wish to see its consequences worked out further. Next follows the investigation of a number of mathematical problems on heat conduction. Unfortunately an error appears to have crept on p. 139 where in the 6th line there should occur 'reversible' instead of 'irreversible'.

Part III deals with the theory of heat radiation and follows the plan adopted by the author in his well-known book entitled 'Heat Radiation' (Warmestrahlung). In deducing Wien's displacement law the author

has started with the concept of entropy radiation and applies the laws of geometrical optics to the propagation of this entropy radiation. The deduction is logically very elegant.

Part IV deals with the statistical and the quantum theories of heat. It gives a very clear and logical account of the subject-matter leading up to the quantum statistics and Planck's law of distribution of energy. The last chapter deals briefly with the evaluation of the sum of states, the deduction of gas laws, chemical constant and connected topics. The chapter could have included with advantage accounts of the application of the quantum theory to specific heat of solids and gases, of Bose-Einstein and Fermi-Dirac statistics.

The book thus gives an authoritative account of the theory of heat leading up to the modern developments such as the quantum theory, statistical theory and quantum statistics. The exposition is very lucid and logical and the book will form a valuable addition to the literature on Heat in English.

M. N. SAHA.

* * *

TEXT-BOOK OF PALÆONTOLOGY. By Karl A. Von Zittel. Translated by C. R. Eastman, revised with additions by Sir Arthur Smith Woodward. Vol. II with 533 illustrations, pp. xvii+453. Price 30 shillings nett. Macmillan & Co., Ltd., London.

The second volume of Zittel's series of Text-books of Palæontology has been out of print for some years and its publication, revised and in many cases rewritten so as to incorporate many new discoveries made since the publication of the first English edition, will be widely welcomed. The original form of the book remains the same and the method of treatment adopted by the author is still preserved. This volume deals with vertebrates upto mammals which are treated in the third volume.

We have no hesitation in saying that the book is an excellent work of reference in the hands of experts, but we doubt very much if it can be used by the general student of zoology or for class purposes. It is really a systematic work with figures and illustrations useful for taxonomic purposes. The definitions and diagnostic characteristics might with great advantage have been rendered fuller so as to make the usefulness of the book more general. A uniform treatment of the several fossil groups is impossible of attainment unless our knowledge of them is as complete as that of living forms and a systematic work like that of Zittel's text-books can only be used with great caution and with obvious limitations by students of general palæontology.

The study of zoology is incomplete without a proper training in Palæontology and provision is accordingly made in the syllabuses of zoology for the inclusion of the study of fossil forms. The evidence furnished by the animals in remote ages to the evolutionary concept of life is indispensable to the teaching of zoology and viewed from this standpoint the book furnishes very few materials. For instance, the evolution of the caudal structures of fishes is an extremely fascinating subject; the inter-relationships of the vertebral elements in the different parts of the dorsal axis, and structure of the skull are other interesting studies which should have been discussed in the introductory section on Pisces. To students of zoology and general palæontology, the origin of pentadactyle limbs of Tetrapoda possesses great attraction and in the chapter on Amphibia, one would expect to find a reference to the numerous theories which have been advanced to derive the tetrapod limbs from the gill arches and fins of fishes. In the chapter on Reptilia the description of the vertebral column should have included a discussion on the evidence provided by the Stegocephalia and Proreptilia in regard to the difference in the development of the vertebræ in the groups Amphibia and Reptilia. Similarly the description of the atlas of crocodiles might have been made fuller by comparison with its structure in *Metrorhynchus* and *Sphenodon* and pointed out how the epistropheous has come to bear two ribs. There are several other subjects which could have been treated from the standpoint of comparative study and we have no doubt that such a treatment of the subject would have made the book an invaluable possession to students of zoology.

But for these details which certainly would enhance the value and usefulness of the book, we have a genuine regard for the excellent and lucid method of exposition adopted in the treatment of what is generally regarded as dry and uninviting portion of palæontology. The illustrations include old figures of actual fossils and several new ones have been incorporated, taken from the fourth German edition, besides diagrams from original papers. The bibliographies under different sections have been enriched

by the addition of newer literature and this is a source of great advantage to students working on any particular group.

The introductory chapters which are intended to be general introduction to the various classes give sufficient information for pursuing the study of the anatomy of the fossils comprehended under them. We welcome this English edition of Zittel as a great addition to our works of reference which will provide the necessary guidance and stimulus to all students interested not only in the study of palæontology but also in general zoology.

C. R. N.

* * *

VON DAVY UND DÖBEREINER BIS DEACON, ein halbes Jahrhundert Grenzflächenkatalyse. (From Davy and Döbereiner to Deacon; A Half Century of Contact Catalysis.) By Alwin Mittasch, and Erich Theis. Verlag Chemie G.m.b.H., Berlin, 1932. 278 pp. Price Mk. 18·50.

A history of chemistry may be of the descriptive type in which case it must suffer by the omission of many material facts or it may be encyclopædic and consequently somewhat disjointed and uninteresting. The authors of the volume under review have endeavoured to combine the advantages of both types by adopting a system of comprehensive foot-notes which occupy some 25 per cent. of the whole volume; the main text has in consequence a fair degree of continuity, but it is still to be noticed in many cases, that those pages with the fewest foot-notes afford the most pleasant reading.

There is no doubt regarding the encyclopædic character; the authors appear to have taken immense pains to let no reference to contact catalysis, however insignificant or obscure, escape their notice. Many little-known facts have thus been brought to light and curiosity aroused regarding the life and work of authors whose names are unfamiliar. It is only to be regretted that in a work of modest dimensions fuller details cannot be given.

As a description of contemporary thought and work the book is less happy. The most interesting chapters are those dealing with platinum and the synthesis of ammonia, as these are in the nature of a review of the ideas of all who were interested in these outstanding problems of their time. The remainder is somewhat disjointed, as is bound to be the case when a single subject is considered. The value of studying the lives of great scientists lies largely in following the line of thought which led from one discovery to another and in examining their methods of conducting experiments with the crude apparatus available. The authors have done what they can to bring in the personal element by the inclusion of illustrations, sketches of apparatus and occasional quotations but in spite of this there remains a feeling that something is wanting. The reason is undoubtedly the presence of so many references, but as these form an essential part of the work, it is evident that the failing is one that cannot be corrected. Too much attention should not therefore be paid to this aspect. The real value lies in the thoroughness with which the matter has been compiled and as a book reference for all who are interested in the history of chemistry and students preparing for examinations the volume can be highly recommended. H. E. W.

* * *

LEHRBUCH DER ANORGANISCHEN CHEMIE (Text-book of Inorganic Chemistry). By Dr. Heinrich Remy. Akademische Verlagsgesellschaft m.b.H., Leipzig, 1931. Vol I, xxii+718 pp., 92 figs. Vol. II, xvi+450 pp., 32 figs. Price, Vol. I, RM. 20; Vol. II, RM. 14.

The most noteworthy feature of this new text-book is that in the small range of two volumes consisting of about 1,150 pages, the field brought under survey includes not only the whole of inorganic chemistry, but in addition the theoretical aspects of general and physical chemistry with their applications to special problems. The first volume deals with the elements of the sub-group A of the first three groups and the sub-groups B of the next four groups of the periodic table. The elements of a single family (*e.g.*, lithium, sodium, potassium, rubidium, caesium) are treated together in one chapter which presents at the outset the results of recent work concerning their general characteristics, such as normal potentials, ionic and atomic radii, crystal structure, compressibility and spectra, along with their methods of preparation and chief uses; the larger part of the chapter, however, is devoted to a descriptive account of their compounds. The second volume covers the elements not treated in the first volume and these include the transition groups and the rare earths, the method of treatment being similar to that adopted in the first volume.

Important considerations of theoretical chemistry such as Bohr's theory of the hydrogen atom, Kossel's theory of valency, X-Rays and crystal structure, and the co-ordination theory of valency, are dealt with very clearly in separate chapters in appropriate positions of the first volume. Although the usefulness of the book is unquestionably enhanced by this procedure, it is to be regretted that it has entailed the curtailing of portions dealing with preparative and analytical chemistry. The second volume, however, is free from this drawback and gives as full an account of the elements and compounds coming within its scope as is to be found only in much larger treatises.

The two volumes of this work form a valuable addition to the existing text-books of inorganic chemistry and are certain to prove of great use to students of chemistry in the honours courses of our universities as well as to lecturers on the subject.

K. R. K.

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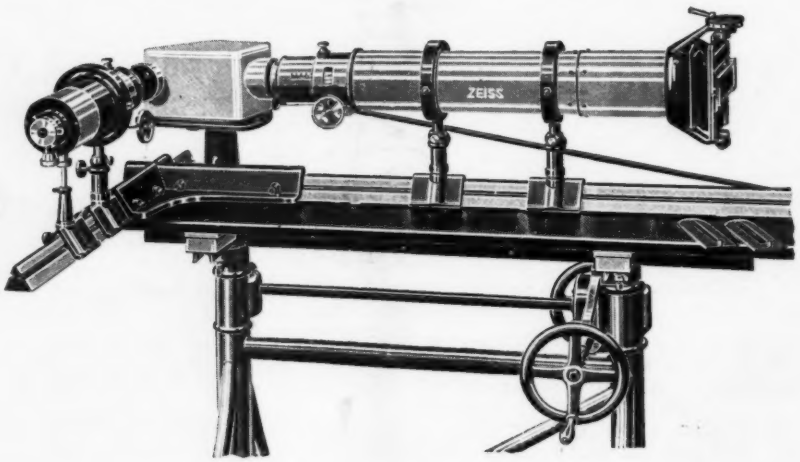

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